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Attorney Docket No. 381/41092  
PATENT

93 APR 16 AM 11:59

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

GROUP 350

Applicant: Hiroshi ONISHI, et al.

Serial No.: 07/985,199

Group: TBD

Filed: December 3, 1992

Examiner: TBD

For: AUTOMATIC TRANSMISSION CONTROL SYSTEM FOR AN AUTOMOBILE

PETITION TO GRANT FILING DATE

Honorable Commissioner of  
Patents and Trademarks  
Washington, D.C. 20231  
Attn: Office of Assistant Commissioner  
for Patents

February 19, 1993

Sir:

Pursuant to 37 C.F.R. § 1.181, applicant in the above-captioned U.S. Patent Application hereby petitions the Commissioner, acting through the Office of the Assistant Commissioner for Patents, to grant a filing date of December 3, 1992, for the subject application. The petition fee of \$130.00 as provided in 37 C.F.R. § 1.17(h) is enclosed herewith. In support of this petition, applicant submits the following statement of facts and argument.

Statement of Facts

1. The subject U.S. Patent Application was filed on December 3, 1992, by depositing the same with the Mail Room at the U.S. Patent and Trademark Office.

2. Attachment 1 hereto is a copy of the Application papers as filed on December 3, 1992. They include the following:

1.a. transmittal letter dated December 3, 1992;

- 1.b. specification, together with 21 claims and 21 sheets of drawings;
- 1.c. Japanese Application No. 03-319205, filed in Japan on December 3, 1991; and
- 1.d. Preliminary Amendment dated December 3, 1992.

These documents were accompanied by a check for the required filing fee in the amount of \$754.00.

3. A claim for foreign priority under 35 U.S.C. § 119 was asserted in the transmittal letter (Attachment 1.a) hereto, based on the Japanese Patent Application No. 03-319205 (Attachment 1.c hereto).

4. Because of a change of clerical personnel which occurred shortly prior to the filing in question, the present application was accompanied by a form of transmittal letter (Attachment 1.a. hereto) which differed from that ordinarily employed by counsel for such filings, which latter form identifies the inventors by name in a space specifically provided therefor. The omission of some of the inventors' names in the former was not detected by counsel at the time the transmittal papers were executed.

5. Attachment 2 is a certified translation of page 1 of Japanese Patent Application No. 03-319205 (Attachment 1.c), which was filed with, and as part of, the subject application. As this translation shows, page 1 of the Japanese priority application identifies the inventors as the following:

INVENTOR:

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INVENTOR:  
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6. Subsequent to filing of the above papers, applicant received a Notice of Incomplete Application dated January 6, 1993, indicating that a filing date had not been granted because the inventors' names were missing from the papers as filed. A copy of the Notice of Incomplete Application is Attachment 3 hereto.

7. Applicant has responded to the Notice of Incomplete Application by the submission on February 4, 1993, of a Preliminary Amendment identifying the names of the inventors in English, in order to avoid any further delay in the granting of a filing date. However, for the reasons set forth hereinbelow applicant submits that a filing date of December 3, 1992, for this application is proper.

#### Argument

Based on the foregoing facts, applicant respectfully submits that this application was complete on the date it was originally filed with the U.S. Patent and Trademark Office, December 3, 1992. Although the English language papers did not identify all

the inventors, Attachment 2 hereto shows that the inventors were identified by name in the accompanying Japanese patent application, which was filed with the present application on December 3, 1992. As noted in the above statement of facts, the Japanese application was specifically referred to and identified in the transmittal letter which accompanied the present application, and a claim of priority was made based thereon. Although this application is not in the English language, 37 C.F.R. § 1.52(d) provides that an application may be filed in a language other than English. This being the case, it follows that the inclusion of the Japanese patent application identifying the names of the inventors, is sufficient to satisfy the requirement of 37 C.F.R. § 1.53(b) that the inventors' names be provided.

It would be appreciated if the undersigned were telephoned if there are any questions concerning this *Petition to Grant Filing Date* or the application in general.

Please credit any overpayments or charge any additional fees to the Deposit Account of Evenson, McKeown, Edwards & Lenahan, Account No. 05-1323.

Respectfully submitted,

EVENSON, MCKEOWN, EDWARDS & LENAHAH



Gary R. Edwards, Reg. No. 31,824  
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jdl



UNITED STATES DEPARTMENT OF COMMERCE  
Patent and Trademark Office

Address: COMMISSIONER OF PATENTS AND TRADEMARKS  
Washington, D.C. 20231

SERIAL NUMBER	FILING DATE	FIRST NAMED APPLICANT	ATTY. DOCKET NO.
07/985,199	12/03/92	ONISHI	H 381/41092
[ EVENSON, WANDS, EDWARDS, LENAHAN & MCKEOWN 1200 G ST. NW., STE 700 WASHINGTON, DC 20005 ]			0000

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01/06/93

**Notice of Incomplete Application**

A filing date has NOT been assigned to the above identified application papers for the reason(s) shown below.

1. ☐ The specification (description and claims):
  - a. ☐ is missing
  - b. ☐ has pages \_\_\_\_\_ missing.
  - c. ☐ does not include a written description of the invention.
  - d. ☐ does not include at least one claim in compliance with 35 U.S.C. 112.
- A complete specification in compliance with 35 U.S.C. 112 is required.
2. ☐ A drawing of Figure(s) \_\_\_\_\_ described in the specification is required in compliance with 35 U.S.C. 111.
3. ☐ A drawing of applicant's invention is required since it is necessary for the understanding of the subject matter of the invention in compliance with 35 U.S.C. 113.
4. ☒ The inventor's name(s) is missing. The full names of all inventors are required in compliance with 37 CFR 1.41.
5. ☐ Other:

All of the above-noted omissions, unless otherwise indicated, must be submitted within TWO MONTHS of the date of this notice or the application will be returned or otherwise disposed of. Any fee which has been submitted will be refunded less a \$15.00 handling fee. See 37 CFR 1.53(c).

The filing date will be the date of receipt of all the items required above, unless otherwise indicated. Any assertions that the items required above were submitted, or are not necessary for a filing date, must be by way of a petition directed to the attention of the Office of the Assistant Commissioner for Patents accompanied by the \$140.00 petition fee (37 CFR 1.17(h)). If the petition alleges that no defect exists, a request for refund of the petition fee may be included in the petition.

Direct the response to, and questions about, this notice to the undersigned, Attention: Application Branch.

**A copy of this notice MUST be returned with response.**

Enclosed:

- ☐ "General Information Concerning Patents". See page \_\_\_\_\_.
- ☐ Copy of a patent to assist applicant in making corrections.
- ☒ "Notice to File Missing Parts of Application", Form PTO-1532.
- ☐ Other: \_\_\_\_\_

For: Manager, Application Branch  
(703) 567-3254

FORM PTO-1123 (REV. 7-87)

ATTORNEY'S/APPLICANTS COPY

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GROUP 350

Patent ☒ Trademark ☐ 381/41092  
Serial No. 07/985,199 Filed December 15, 1992  
Applicant(s) Huashi ONISHI, et al  
Papers filed herewith on February 17, 1993  
☒ Fees \$ 130.00 for Petition ☐ Assignment  
☐ New Application CL No. 1457 ☐ Letter to Draftsman  
☐ Amendment ☐ Priority Documents  
☐ Notice of Appeal ☐ Petition for Ext. of Time  
☐ Appeal Brief ☐ Sheets of Formal Drawings  
☐ Other Petition to Grant Final Written Decision  
ment to be made in petition

Receipt is hereby acknowledged of the papers filed as indicated in connection with above identified case.

COMMISSIONER OF PATENTS AND TRADEMARKS

FILING RECEIPT



UNITED STATES DEPARTMENT OF COMMERCE  
Patent and Trademark Office  
ASSISTANT SECRETARY AND COMMISSIONER  
OF PATENTS AND TRADEMARKS  
Washington, D.C. 20230

SERIAL NUMBER	FILING DATE	GRP ART UNIT	FIL FEE REC'D	ATTORNEY DOCKET NO.	DRWGS	TOT CL	IND CL
07/985,199	02/04/93	3502	\$ 884.00	381/41092	20	17	2

GROUP 350

EVENSON, MCKEOWN, EDWARDS & LENAHA  
1200 G STREET, N.W., SUITE 700  
WASHINGTON, DC 20005

Receipt is acknowledged of the patent application identified herein. It will be considered in its order and you will be notified as to the examination thereof. Be sure to give the U.S. SERIAL NUMBER, DATE OF FILING, NAME OF APPLICANT, and TITLE OF INVENTION when inquiring about this application. Fees transmitted by check or draft are subject to collection. Please verify the accuracy of the data presented on this transmittal.

Applicant(s)

HIROSHI OHNISHI, KATSUTA-SHI, JAPAN; KOUJI KITANO,  
KAGAWA-KEN, JAPAN; MITSUO KAYANO, HITACHI-SHI, JAPAN;  
NOBUO KURIHARA, HITACHIOTA-SHI, JAPAN.

FOREIGN/PCT APPLICATIONS-JAPAN

3-319205

12/03/91

TITLE  
AUTOMATIC TRANSMISSION CONTROL SYSTEM FOR AN AUTOMOBILE  
PRELIMINARY CLASS: 074

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(see reverse)

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December 3, 1992

**BOX PATENT APPLICATION**

Honorable Commissioner of  
Patents and Trademarks  
Washington, D.C. 20231

Re: Application of Hiroshi ONISHI et al.  
"AUTOMATIC TRANSMISSION CONTROL SYSTEM  
FOR AN AUTOMOBILE"  
Our Ref: 381/41092

Dear Sir:

Attached hereto is the application identified above including the Specification, Twenty-one (21) Claims, Twenty (21) sheets of drawings of Figures 1-21(c), Japanese Priority Document and claim for priority, and Preliminary Amendment. The executed Declaration and Power of Attorney will be submitted at a later date.

The Government filing fee is calculated as follows:

Total claims .....	22	- 20 =	2	x \$22 =	44.00
Independent Claims .....	3	- 3 =	0	x \$74 =	0
Base Fee .....					\$710.00
Multiple Dependent Claim Fee (\$230.00) .....					
<b>TOTAL FILING FEE .....</b>					<b>\$754.00</b>

A check for the statutory filing fee of \$754.00 is attached. You are also directed and authorized to charge or credit any difference or overpayment to Deposit Account No. 05/1323. The Commissioner is hereby authorized to charge any fees under 37 C.F.R. 1.16 and 1.17 which may be required during the entire pendency of the application to Deposit Account No. 05/1323 (381/41092). A duplicate copy of this transmittal letter is attached.



Priority is claimed from Japanese Patent Application No. 03-319205, filed in Japan on December 3, 1991. The certified copy of the priority document is enclosed.

Respectfully submitted,

EVENSON, WANDS, EDWARDS,  
LENAHAN & McKEOWN



Donald D. Evenson  
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**BERLITZ**

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C E R T I F I C A T I O N

This is to certify that the following is, to the best of our knowledge  
and belief, a true and accurate translation into English  
of the attached Japanese language document (03-319205)

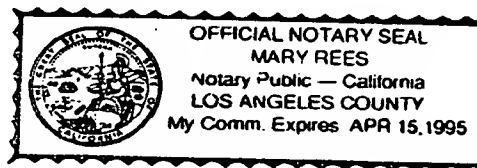
*Chie*

BERLITZ TRANSLATION SERVICES

STATE OF CALIFORNIA )  
COUNTY OF LOS ANGELES ) SS

Sworn and subscribed to before me this 18th day of February 1993.

*Mary Rees*  
NOTARY PUBLIC



03-319205

Document Title: Patent Application

Reference No.: HA05679000

Date of Petition: December 3, 1991

Submitted to: Patent Office Director

International Patent Classification(s): F16H 59/66  
F16H 59/52  
F16H 59/60

Name of Invention: Automatic transmission control device for automobiles

Number of Claims: 6

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04-063184

【審判名】 特許願

【整理番号】 HA05G79000

【提出日】 平成 3年12月 3日

【あて先】 特許庁長官 殿

【国際特許分類】 F16H 59/G6  
F16H 59/52  
F16H 59/60

【発明の名称】 自動車の自動変速制御装置

【請求項の数】 6

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**AUTOMATIC TRANSMISSION CONTROL SYSTEM FOR  
AN AUTOMOBILE**

**BACKGROUND OF THE INVENTION**

5

The present invention relates to transmission control systems for automobiles.

10

A prior-art transmission control system for an automobile is so constructed that a vehicle speed and a throttle valve opening are sensed as electric signals, and that a predetermined shift gear corresponding to the current values of the vehicle speed and the throttle valve opening is selected on the basis of a shift pattern which is preset, with the vehicle speed and the throttle valve opening as variables. Herein, a plurality of such shift patterns are set beforehand, and one of them is selected by the manipulation of the driver of the automobile.

15

20

In another transmission control system, the shift patterns are automatically selected and changed-over in accordance with the driving operation of the driver.

25

The control of a transmission in the prior art is such that a predetermined gear position corresponding to the current values of a vehicle speed and a throttle valve opening is selected on the basis of a shift pattern which is preset, with the vehicle speed and the throttle valve opening as variables.

In addition, the official gazette of Japanese Patent Application Publication No. 45976/1988 discloses a technique wherein a torque is evaluated from the pressure of an intake pipe, and a transmission gear ratio [(r. p. m. of an  
5 internal combustion engine)/(vehicle speed)] is determined from the torque.

These methods have made the performing an exact shift operation for the fluctuations of drive conditions difficult, especially for the change of a running load. For  
10 example, it is considered that the fuel consumption of the automobile will be enhanced without spoiling the drivability thereof, by upshifting earlier on a flat road or a gentle downward slope rather than on an upward slope. Such a shift operation, however, has heretofore been impossible because  
15 of the gear shift based on only the throttle valve opening and the vehicle speed.

Besides, as the vehicle is lightened, it becomes important to perform the shift control so as to correspond to the change of acceleration characteristics dependent upon  
20 the weight of the vehicle in the case of a starting acceleration. It is therefore considered possible to enhance the fuel consumption and to perform the exact shift operation corresponding to the drive conditions, in such a way that the running load and the vehicle weight are  
25 estimated, and that the shift pattern is changed in accordance with the vehicle weight and the running load in

an accelerating mode, while it also is changed in accordance with the running load in a decelerating mode.

Since the shift pattern is determined on the basis of the several typical drive conditions as stated above, the prior-art techniques have been sometimes incapable of the shift operation which reflects the drive conditions exactly. As a result, they have often worsened the fuel consumption.

#### SUMMARY OF THE INVENTION

An object of the present invention is to provide an automatic transmission control system for an automobile in which the running load of the automobile is estimated so as to perform a shift operation which conforms to the running load.

In order to accomplish the object, an automatic transmission control system for an automobile in one aspect of performance of the present invention is constructed comprising load computation means for computing the automobile load; output torque estimation means for calculating an output torque with reference to the torque characteristics of the drive train of the automobile; running load estimation means for estimating a running load from the automobile load and the output torque; memory means for storing at least two shift schedules therein; and a shift schedule variable-control unit which determines a

shift schedule of an automatic transmission of the automobile during actual running of the automobile, on the basis of the estimated running load and the stored shift schedules.

5            Besides, in order to perform a shift operation which is based on, not only a running load, but also an estimated vehicle weight of an automobile, an automatic transmission control system for an automobile in another aspect of performance of the present invention may well be constructed  
10   comprising vehicle weight estimation means for estimating weight of the automobile; torque estimation means for estimating an output torque; acceleration input means for accepting an acceleration signal; running load estimation means for estimating the running load from the estimated  
15   vehicle weight, the estimated output torque and the input acceleration; memory means for storing a plurality of shift schedules therein; and gear position determination means for selecting one of the shift schedules on the basis of the vehicle weight and the estimated running load, and for  
20   determining a gear position of an automatic transmission of the automobile in accordance with the selected shift schedule.

          In operation, the running load (and the vehicle weight) is (are) estimated, and the shift operation is performed in  
25   conformity with the vehicle weight and the running load. Therefore, the optimal shift pattern is formed in accordance



with a driving environment such as a mountain path, to enhance the drivability of the automobile. Moreover, on a flat road, the fuel consumption of the automobile is enhanced.

5

#### BRIEF DESCRIPTION OF THE DRAWINGS

Fig. 1 is a block diagram of a shift control system which includes an automatic transmission control system in an embodiment of the present invention;

10

Fig. 2 is a schematic block diagram showing the hardware elements of the shift control system depicted in Fig. 1;

Fig. 3 is an explanatory diagram showing the details of input signals to and output signals from an AT (automatic transmission) control unit;

15

Fig. 4 is a block diagram of a vehicle weight estimation section which includes vehicle weight estimation means;

20

Fig. 5 is a diagram for explaining the time serialization of an acceleration response waveform;

Figs. 6A and 6B are diagrams for explaining a method of starting the time serialization;

Fig. 7 is a diagram for explaining the flow of processing for the generation of a time serialization start signal;

25

Fig. 8 is a flow chart showing the processing steps of means for generating the time serialization start signal;

Fig. 9 is a diagram for explaining the learning method of a neural network which is used in the vehicle weight estimation means depicted in Fig. 4;

Fig. 10 is a block diagram of a shift control section which includes torque converter-generated torque estimation means, engine-generated torque estimation means and load estimation means;

Figs. 11(a) and 11(b) are graphs showing an engine torque map and a torque converter characteristic map, respectively;

Fig. 12 is a flow chart showing a process for estimating an accessory torque;

Fig. 13 is a flow chart showing a process for estimating a torque generated by an engine;

Fig. 14 is a flow chart showing a process for estimating an output torque based on a torque converter;

Fig. 15 is a flow chart showing a process for estimating a running load torque from the estimated output torque;

Fig. 16 is a flow chart showing another method of the process for estimating the accessory torque;

Fig. 17 is a schematic block diagram for explaining gear position determination means;

Figs. 18(a) and 18(b) are explanatory diagrams

showing shift maps in a method of altering shift schedules which are based on load estimation and vehicle weight estimation;

5 Fig. 19 is a block diagram of an automatic transmission control system being another embodiment in which a shift schedule is continuously varied in consideration of a grade or slope;

Fig. 20 is an explanatory diagram showing a shift map in the embodiment illustrated in Fig. 19; and

10 Figs. 21(a), 21(b) and 21(c) are graphs for explaining how to decide an acceleration request.

#### PREFERRED EMBODIMENTS OF THE INVENTION

15 Now, embodiments of the present invention will be described with reference to the drawings. In the ensuing description, an expression "change gear ratio" or "gear ratio" shall mean the product between the gear ratio of a transmission and that of a final drive.

20 The schematic construction of an automatic transmission control system for an automobile in one embodiment of the present invention is illustrated in Fig. 1.

Throttle valve opening (TVO) sensing means 101 senses a throttle valve opening 121 in the automobile, which is  
25 delivered to vehicle weight estimation means 106, engine-generated torque estimation means 1001 and gear position

determination means 109.

Acceleration sensing means 102 senses the acceleration 122 of the automobile, which is delivered to the vehicle weight estimation means 106 and load estimation means 110.

5        Vehicle speed sensing means 103 senses the vehicle speed 123 of the automobile, which is delivered to the vehicle weight estimation means 106 and the gear position determination means 109.

10        Engine r. p. m. sensing means 104 senses engine r. p. m. ("revolutions per minute" also termed an "engine speed") 124 in the automobile, which is delivered to torque converter-generated torque estimation means 107 and the engine-generated torque estimation means 1001. The torque converter-generated torque estimation means 107 and the  
15        engine-generated torque estimation means 1001 are means for estimating torques generated by the torque converter of the automobile and the engine thereof, respectively.

20        Turbine r. p. m. sensing means 105 senses turbine r. p. m. (also termed a "turbine speed") 125 in the automobile, which is delivered to the torque converter-generated torque estimation means 107.

25        In the vehicle weight estimation means 106, the vehicle weight of the automobile is estimated on the basis of the throttle valve opening 121, acceleration 122 and vehicle speed 123. The estimated vehicle weight 126 is delivered to the gear position determination means 109 and the load

estimation means 110.

In the torque converter-generated torque estimation means 107, the torque generated by the torque converter is estimated from the engine speed 124 and the turbine speed  
5 125. The estimated torque 1022 generated by the torque converter is delivered to the load estimation means 110.

In the engine-generated torque estimation means 1001, the torque generated by the engine is estimated from the throttle valve opening 121 and the engine speed 124. The  
10 estimated torque 1015 generated by the engine is delivered to the torque converter-generated torque estimation means 107.

In the load estimation means 110, a load torque is estimated from the estimated vehicle weight 126, the  
15 estimated torque 1022 generated by the torque converter, and the acceleration 122. The estimated load torque 1028 is delivered to the gear position determination means 109.

In the gear position determination means (which is also means for storing shift schedules therein) 109, a gear  
20 position is determined on the basis of the throttle valve opening 121, vehicle speed 123, vehicle weight 126 and load torque 1028. The determined gear position 129 is delivered to hydraulic drive means 111.

The hydraulic drive means 111 determines the driving  
25 hydraulic pressure of the clutch of the automatic transmission and drives the clutch so as to establish the

determined gear position 129.

Fig. 2 illustrates the arrangement of an engine and drive train and a control unit therefor for use in the embodiment of the present invention. An engine 201 and a transmission 202 supply the AT (automatic transmission) control unit 203 with signals 204 and 205 indicative of their respective operating states. In addition, vehicle signals 207 and ASCD (auto speed cruising device) control unit signals 208 are input to the AT control unit 203. In the AT control unit 203, a gear position is determined from the received signals so as to deliver shift instruction signals 206 to the transmission 202.

Fig. 3 illustrates the details of the signals shown in Fig. 2. Signals 304 thru 307 in Fig. 3 correspond to the engine output signals 204 in Fig. 2, while signals 308 thru 310 correspond to the transmission output signals 205. Besides, signals 311 thru 314 correspond to the vehicle signals 207, while signals 315 and 316 correspond to the ASCD control unit signals 208. On the other hand, signals 317 thru 321 correspond to the AT control unit signals 206. In Fig. 3, the input signals 304 ~ 316 are supplied to an AT control unit 301 through an input signal processing unit 302. Further, the output signals 317 ~ 321 from the AT control unit 301 are delivered through an output signal processing unit 303.

In the present invention, a vehicle weight estimating

method utilizes the fact that the corresponding accelerating operation of the acceleration and the vehicle speed, which arise when the driver of the automobile has depressed the accelerator pedal thereof, differs depending upon the vehicle weight. Thus, the vehicle weight is recognized from an accelerating response waveform. With this method, the cost of the control system is not increased by the use of a sensor for measuring the vehicle weight, and the vehicle weight can be estimated at a precision satisfactory for the shift control of the automatic transmission.

Fig. 4 is a detailed block diagram showing an example of the vehicle weight estimation means 106 depicted in Fig. 1. In Fig. 4, acceleration sensing means 401 delivers an acceleration 411 to time serialization means (acceleration input means) 405 and time serialization start signal generation means 404. Vehicle speed sensing means 402 delivers a vehicle speed 412 to the time serialization means 405. TVO sensing means 403 delivers a throttle valve opening 413 to the time serialization means 405 and the time serialization start signal generation means 404.

The time serialization start signal generation means 404 monitors both the signals of the acceleration 411 and the throttle valve opening 413, and it sends a signal 416 to the time serialization means 405 so as to start or initiate time serialization when the acceleration has risen owing to the driver's depression of the accelerator pedal, in other

words, in conformity with the accelerating response waveform.

Upon receiving the time serialization start signal 416, the time serialization means 405 time-serializes the acceleration 411, vehicle speed 412 and throttle valve opening 413 so as to deliver time-serial signals 414 to neural vehicle weight estimation means 406. The neural vehicle weight estimation means 406 estimates the vehicle weight on the basis of the received time-serial signals 414, and delivers an estimated vehicle weight 415.

Fig. 5 is a diagram for explaining the time serialization of the accelerating responses of the acceleration, vehicle speed and throttle valve opening. The time serialization is started at the point of time  $t_{so}$  at which the acceleration has exceeded a predetermined threshold value  $\alpha_{th}$ . Then, the acceleration, vehicle speed and throttle valve opening are sampled at regular intervals of  $\Delta t$ .

The reason why the threshold value is set for the acceleration will be elucidated with reference to Figs. 6A and 6B. In a case where a threshold value is set for the throttle valve opening for the purpose of the time serialization in the accelerating mode and where the sampling is initiated in synchronism with the rise of the throttle valve opening, the rise of the longitudinal acceleration (the acceleration in the longitudinal direction



of the body of the automobile) becomes discrepant because of an individual difference involved in the way the driver depresses the accelerator pedal. In order to eliminate the discrepancy, the threshold value is set for the acceleration, and the sampling is started when the acceleration has exceeded the threshold value.

Fig. 7 illustrates the procedure of the processing of the time serialization start signal generation means 404 shown in Fig. 4. First, the closure of a throttle valve is confirmed. Subsequently, the opening of the throttle valve rises and exceeds the preset threshold value. Thereafter, the time serialization is initiated when the acceleration has exceeded the threshold value.

Fig. 8 illustrates the flow of that processing of the time serialization start signal generation means 404 which corresponds to Fig. 5. More specifically, whether or not the throttle valve is closed is checked at a step 801. When the throttle valve is closed, the processing flow proceeds to a step 802, and when not, it returns to the step 801. Further, when the throttle valve opening  $\theta$  has exceeded its threshold value  $\theta_{th}$  at the step 802, the processing flow proceeds to a step 803, and when not, it returns to the step 802. On condition that the acceleration  $\alpha$  has exceeded its threshold value  $\alpha_{th}$  at the step 803, the processing flow proceeds to a step 804. Otherwise, the processing flow returns to the step 803. At the step 804, the time

serialization start signal 416 indicated in Fig. 4 is delivered.

Fig. 9 is a diagram showing the learning method of a neural network which is used for the estimation of the vehicle weight. Referring to the figure, vehicle weight estimation means 901 is constructed of the Rumelhart type neural network which consists of the three layers of an input layer, an intermediate layer and an output layer. Each of the layers includes one or more neurons or arithmetic elements, and the neurons of the adjacent layers are coupled by synapses. Signals are transmitted along the input layer → the intermediate layer → the output layer. Each of the synapses is endowed with a weight, and the output signal of the corresponding neuron is multiplied by the weight of the synapse to form the input signal of the next neuron. Each neuron converts the sum of the input signals into the output signal by the use of a sigmoidal function.

The neural network 901 learns the vehicle weight in such a way that the weights of the respective synapses are so altered as to diminish the error between the true weight of the automobile and the vehicle weight estimated from the inputs of the acceleration, vehicle speed and throttle valve opening. In order to cope with various aspects of depressing the accelerator pedal, accelerating response waveforms are previously measured by experiments based on

the time serialization method shown in Fig. 4, while the vehicle weight and the throttle valve opening are being changed on an identical automobile. Subsequently, the time-serial waveforms of the acceleration, vehicle speed and throttle valve opening are input to the neural network 901, thereby obtaining the estimated vehicle weight 911. Next, the error 913 of the estimated vehicle weight 911 with respect to the true vehicle weight 912 is calculated.

Weight alteration means 902 alters the weights of the inter-layer synapses so as to diminish the error 913 between the estimated vehicle weight 911 and the true vehicle weight 912. As an algorithm for altering the weights, a back-propagation algorithm is typical, but another algorithm may well be employed.

A running load is estimated in order to perform the shift control in accordance therewith. Herein, the running load is evaluated by estimating an output torque and solving the equation of motion on the basis of the estimated output torque, the acceleration and the estimated vehicle weight.

Regarding the output torque estimation, there are a method in which the output torque is estimated from the slip and r. p. m. (also termed "revolution number" or "speed") of the torque converter in accordance with torque converter characteristics, and a method in which it is estimated from the r. p. m. of the engine and the opening of the throttle

valve in accordance with engine torque characteristics.

The estimation method based on the slip of the torque converter can estimate the output torque precisely when the slip of the torque converter is great, that is, when the ratio between the revolutions of the input and output of the torque converter is small. This method, however, exhibits an inferior precision in a region where the slip is small, that is, where the ratio between the input revolutions and the output revolutions is great.

On the other hand, the estimation method based on the engine torque characteristics exhibits a constant precision in the whole operating region of the engine, but it has the problem that torques required for operating accessories such as an air conditioner cannot be found.

In this embodiment, accordingly, in the region where the slip of the torque converter is great, the output torque is estimated on the basis of the torque converter, while at the same time, the torques necessary for operating the accessories such as the air conditioner are estimated.

Besides, in the region where the slip of the torque converter is small, the output torque is calculated in such a way that the torques for the accessories estimated before are subtracted from the estimated torque based on the engine.

Fig. 10 is a diagram for explaining the method of estimating the output torque and the method of estimating

the load. In estimating the output torque from a torque generated by the engine, an engine output torque 1015 ( $T_e$ ) is derived from an engine torque map (engine-generated torque estimation means) 1001 on the basis of a throttle valve opening 1011 (TVO) and an engine revolution speed (or r. p. m.) 1012 ( $N_e$ ). The total load torque 1016 ( $T_{acc}$ ) of the accessories such as the air conditioner is subtracted from the engine output torque 1015, and the resulting difference is multiplied by the torque ratio 1017 ( $\tau$ ) of the torque converter, thereby obtaining a turbine torque 1014 ( $T_{t1}$ ) based on the engine revolution speed 1012.

On the other hand, in estimating the output torque from the pump revolution speed or r. p. m. (namely, the engine revolution speed) 1012 and turbine revolution speed or r. p. m. 1013 ( $N_t$ ) of the torque converter, the ratio  $N_t/N_e$  between the turbine revolution speed 1013 and the engine revolution speed 1012 is calculated, and the torque ratio 1017 and pump torque capacity coefficient 1018 ( $\tau$ ) of the torque converter are derived from a torque converter-torque characteristic map 1002. The pump torque capacity coefficient 1018 of the torque converter is multiplied by the square of the engine revolution speed 1012, thereby obtaining a pump torque. Further, the pump torque is multiplied by the torque ratio 1017. Then, a turbine torque 1019 is obtained.

Accessory torque estimation means 1003 compares the

estimated turbine torque 1014 based on the engine and the estimated turbine torque 1019 based on the torque converter. Herein, when the ratio  $N_t/N_e$  between the turbine revolution speed and the engine revolution speed is smaller than 0.8, the estimated accessory torque 1016 is output so as to nullify the error between the turbine output torque 1014 based on the engine and the turbine output torque 1019 based on the torque converter. In contrast, when the ratio  $N_t/N_e$  between the turbine revolution speed and the engine revolution speed is not smaller than 0.8, the latest estimated accessory torque 1016 is output.

Here in this example, the output of the accessory torque estimation means 1003 is changed-over with a boundary at  $N_t/N_e = 0.8$ . However, the value 0.8 differs depending upon the characteristics of torque converters, and a value near the clutch point of the pertinent torque converter may be set. The reason therefor is that the  $N_t/N_e$  values corresponding to the large errors of the pump torque capacity coefficient of the torque converter are bounded by the clutch point.

Turbine torque estimation means 1004 delivers the turbine torque based on the torque converter, as an estimated turbine torque when the ratio  $N_t/N_e$  (1021) between the turbine revolution speed and engine revolution speed of the torque converter is smaller than 0.8, and it delivers the turbine torque based on the engine, as an estimated

turbine torque when not. The estimated turbine torque 1022 ( $T_t$ ) thus produced is multiplied by a gear ratio 1024 ( $r$ ), thereby obtaining an estimated output torque 1023 ( $T_o$ ). An estimated running load torque 1028 ( $T_L$ ) is calculated in such a way that the product 1025 ( $M \times r_w$ ) between the estimated vehicle weight 126 (refer also to Fig. 1) and the effective radius  $r_w$  of a tyre or wheel is multiplied by a longitudinal acceleration 1026 ( $\alpha$ ), whereupon the resulting product 1027 is subtracted from the estimated output torque 1023.

Figs. 11(a) and 11(b) illustrate an engine torque map and a torque converter characteristic map, respectively. The engine torque map in Fig. 11(a) indicates the generated torque  $T_e$  with the throttle valve opening set as a parameter, by taking the revolution speed  $N_e$  of the engine on the axis of abscissas. On the other hand, the torque converter characteristic map in Fig. 11(b) indicates the pump torque capacity coefficient  $\tau$  and the ratio  $i$  of the input and output torques of the torque converter, by taking the ratio  $e$  of the input and output revolutions of the torque converter on the axis of abscissas.

Fig. 12 illustrates the flow of the processing of the accessory torque estimation means 1003 shown in Fig. 10. More specifically, the accessory torque is set at  $T_{acc} = 0$  at a step 1201. If the slip  $e$  of the torque converter, namely, the aforementioned ratio  $N_t/N_e$  between the turbine

revolution speed 1013 and the engine revolution speed 1012 is smaller than 0.8, is checked at a step 1202. When the slip  $s$  is smaller than 0.8, the processing flow proceeds to a step 1203, and when not, it returns to the step 1202. At the step 1203, the difference  $T_{err}$  between the estimated turbine torque  $T_{t1}$  based on the engine and the estimated turbine torque  $T_{t2}$  based on the torque converter is evaluated as  $T_{err} = T_{t1} - T_{t2}$ . At the next step 1204, the estimated accessory torque  $T_{acc}$  is calculated as  $T_{acc} = T_{acc} + T_{err}/t$  where  $t$  denotes the torque ratio of the torque converter.

Fig. 13 illustrates the flow of a process for obtaining the estimated turbine torque  $T_{t1}$  based on the engine. At a step 1301, the values of the engine revolution speed  $N_e$  and the throttle valve opening TVO. At the next step 1302, the engine torque  $T_e$  is derived from the engine torque map 1001 in Fig. 10 (refer also to Fig. 11(a)) on the basis of the engine revolution speed  $N_e$  and the throttle valve opening TVO. At the subsequent step 1303, the turbine torque  $T_{t1}$  based on the engine is calculated in such a way that the accessory torque  $T_{acc}$  is subtracted from the engine torque  $T_e$ , whereupon the resulting difference is multiplied by the torque ratio  $t$  of the torque converter.

Fig. 14 illustrates the flow of a process for obtaining the estimated turbine torque  $T_{t2}$  based on the revolutions of the torque converter. At a step 1401, the values of the



vehicle speed  $V_{sp}$ , engine revolution speed  $N_e$  and gear ratio  $r$  are read. Subsequently, the turbine revolution speed  $N_t$  is computed from the vehicle speed  $V_{sp}$  and the effective radius  $r_w$  of the wheel at a step 1403. At the next step 5 1405, the slip  $s$  of the torque converter is calculated, and the pump torque capacity coefficient  $\tau$  and the torque ratio  $i$  of the torque converter are derived from the torque converter characteristic map 1002 in Fig. 10 (refer also to Fig. 11(b)). At the subsequent step 1406, the turbine 10 torque  $T_{t2}$  (1019 in Fig. 10) based on the torque converter is calculated in such a way that the square of the engine revolution speed  $N_e$  is multiplied by the pump torque capacity coefficient  $\tau$ , thereby obtaining the pump torque  $T_p$ , whereupon the pump torque  $T_p$  is multiplied by the torque 15 ratio  $i$  of the torque converter.

Incidentally, in this process, the turbine revolution number  $N_t$  may well be directly obtained instead of being computed from the vehicle speed  $V_{sp}$ . In such a case, the steps 1401 and 1403 are respectively replaced with steps 20 1402 and 1404. More specifically, the value of the engine revolution speed  $N_e$  is read at the step 1402, and the value of the turbine revolution speed  $N_t$  is read at the step 1404.

Fig. 15 illustrates the flow of a process for obtaining the estimated load torque  $T_L$  from the estimated output 25 torque  $T_o$  and the acceleration  $\alpha$ . If the revolution ratio  $s$  of the torque converter is smaller than 0.8, is checked at a

step 1501. When the ratio  $g$  is smaller, the flow proceeds to a step 1502, and when not, it proceeds to a step 1503. At the step 1502, the estimated turbine torque  $T_t$  is set at the turbine torque  $T_{t2}$  based on the torque converter, whereupon the flow proceeds to a step 1504. On the other hand, at the step 1503, the estimated turbine torque  $T_t$  is set at the turbine torque  $T_{t1}$  based on the engine, whereupon the flow proceeds to the step 1504. Subsequently, at the step 1504, the estimated turbine torque  $T_t$  is multiplied by the gear ratio  $x$ , thereby obtaining the estimated output torque  $T_o$ . At the next step 1505, the estimated load torque  $T_L$  is calculated in such a way that the product among the estimated vehicle weight  $M$ , the effective radius  $r_w$  of the wheel and the acceleration  $\alpha$  is subtracted from the estimated load torque  $T_L$ .

Fig. 16 illustrates another method of evaluating torques required for the accessories. This method consists in that the torques of the accessories are set for the individual devices beforehand, and that, when the pertinent device is "ON", the corresponding value is added. In the figure, the torque of an air conditioner is taken as an example.

At a step 1601,  $T_{acc} = 0$  is set. If the air conditioner is "ON", is checked at a step 1602. When the air conditioner is "ON", the flow of the method proceeds to a step 1603, and when not, the processing of the method is

ended. At the step 1603, the accessory torque  $T_{acc}$  is set at  $T_{acc} = T_{acc} + T_{ac}$  where  $T_{ac}$  denotes the torque of the air conditioner.

There will now be explained a control in which a shift pattern is changed on the basis of an estimated load and an estimated vehicle weight. Fig. 17 is a block diagram of gear position determination means for determining a gear position from the estimated vehicle weight and the estimated load.

An upshifting speed change line selector 1701 receives a vehicle weight signal 1711 and a load signal 1712 as inputs, and it delivers an upshifting speed change line 1714 to gear position final-determination means 1703 as an output. A downshifting speed change line selector 1702 receives the load signal 1712 as an input, and it delivers a downshifting speed change line 1715 as an output. The gear position final-determination means 1703 receives a vehicle speed signal 1716 and a throttle valve opening signal 1717 in addition to the upshifting speed change line 1714 and the downshifting speed change line 1715, and it delivers a gear shift signal 1713.

Figs. 18(a) and 18(b) illustrate the controls based on the vehicle weight and the load, for upshift and for downshift, respectively. A shift map as shown in Fig. 18(a) is used for the upshift, while a shift map as shown in Fig. 18(b) is used for the downshift.

In the case of the upshift, the speed change line moves along lines ①, ② and ③ as the vehicle weight and the load enlarge. On the other hand, in the case of the downshift, the speed change line moves along lines A, B and C as the load enlarges.

In the case of the downshift, when the throttle valve opening ( $\theta + h$ ) is small, the speed change line A moves toward the higher vehicle speed  $V_{sp}$ . This is intended to apply engine braking.

Although the speed change line is determined from the vehicle weight and the running load in the above embodiment, it may well be determined from only the running load.

In addition, although any of the preset speed change lines is selected in the above embodiment, the speed change line may well be continuously varied on the basis of the estimated load, the vehicle weight and a grade or slope. A method for the continuous variation may be such that two speed change lines which do not intersect each other are set, and that they are divided internally or externally in the direction of, for example, the vehicle speed. This method will be explained in detail below.

Fig. 19 is a block diagram showing another embodiment of the automatic transmission control system for an automobile in which the speed change line is determined from the gradient (an inclination angle) and the vehicle weight.

This system comprises a gradient resistance (hill-

climbing resistance) calculation unit (load estimation means) 1901, a continuously variable quantity calculation unit 1902, a continuous variation unit 1903, a shift pattern-A memory 1904 and a shift pattern-B memory 1905.

5 The continuously variable quantity calculation unit 1902 and the continuous variation unit 1903 constitute a shift schedule variable-control unit. The shift pattern-A memory 1904 and the shift pattern-B memory 1905 constitute means for storing shift schedules therein.

10 The gradient resistance calculation unit (load estimation means) 1901 is supplied with the gradient  $\theta$  and the vehicle weight  $W$ , and it calculates a gradient increment resistance  $\Delta L$  in accordance with the following equation (1):

$$\Delta L = W \cdot g \cdot \sin \theta \quad \text{----- (1)}$$

15 where  $g$  denotes the gravitational acceleration.

The continuously variable quantity calculation unit 1902 calculates a continuously variable quantity  $Z$  in accordance with the following equations (2) and (3):

$$y = \frac{\Delta L}{W_{st} \cdot g} \quad \text{----- (2)}$$

20  $(\because y \approx \frac{W}{W_{st}} \cdot \theta)$

$$Z = \varepsilon \cdot y \quad \text{----- (3)}$$

where  $y$  denotes a gradient equivalent coefficient, which may well be calculated by the aforementioned equation  $y \approx \frac{W}{W_{st}} \cdot \theta$ .

25 Besides,  $W_{st}$  represents a standard vehicle weight previously set as a default, and  $\varepsilon$  represents a continuously variable quantity-conversion coefficient.

The continuous variation unit 1903 determines a gear position in such a way that a value X indicated by Equation (4) below is calculated from the continuously variable quantity Z, whereupon the speed change line is variably obtained on the basis of the value X and the throttle valve opening as illustrated in Fig. 20. Shift patterns A and B indicated in Fig. 20 are respectively sent from the shift pattern-A memory 1904 and the shift pattern-B memory 1905. Thus, a smooth shift operation conforming to the gradient is realized.

$$X = X_1 + (X_2 - X_1) \cdot Z \quad \text{----- (4)}$$

There will now be explained a case where a gear position is determined from the vehicle weight, the gradient and an acceleration request. In this case, the gradient increment resistance in Fig. 19 is evaluated as stated below. Processing after the evaluation of the gradient increment resistance is the same as in Fig. 19. First, the temporal variation of the throttle valve opening as shown in Fig. 21(a) is measured. Subsequently, the time derivative of the throttle valve opening is obtained as shown in Fig. 21(b). The acceleration request  $\alpha$  is calculated in accordance with the preset functional relationship of the following equation (5), on the basis of the throttle valve opening (TVO) and the time derivative thereof:

$$\alpha = f(\Delta \text{TVO} / \Delta T, \text{TVO}, t) \quad \text{----- (5)}$$

An example of the obtained result of the acceleration

request  $\alpha$  is shown in Fig. 21(c). In this manner, the presence of the acceleration request  $\alpha$  is decided when the throttle valve opening and the differentiated value thereof have predetermined values or above.

5        The gradient increment resistance  $\Delta L$  is calculated by the following equation (6) on the basis of the vehicle weight  $W$ , the gradient  $\theta$  and the decided acceleration request  $\alpha$ :

$$\Delta L = W \cdot g \cdot \sin \theta + W \cdot \alpha \quad \text{----- (6)}$$

10        With this embodiment, a smooth shift operation with the acceleration request also taken into consideration can be realized.

As described above, according to the present invention, the vehicle weight is estimated from the drive  
 15 characteristics of the automobile, the output torque is estimated from the slip of the torque converter or from the revolution speed of the engine and the opening of the throttle valve, and the running load is estimated from the output torque and the acceleration. Then, in the upshift  
 20 operation, the speed change line is moved by utilizing both the vehicle weight and the running load, while in the downshift operation, it is moved in consideration of only the running load. Thus, the fuel consumption is enhanced, and the exact shift operation conformed to the drive  
 25 conditions is realized.

Incidentally, although the foregoing embodiments have

been described as estimating the vehicle weight, the present invention is not restricted thereto. The vehicle weight may well be directly measured by a sensor.

5 According to the present invention, a running load is estimated, and a shift operation conformed to a vehicle weight and the running load is performed. It is therefore possible to provide an automatic transmission control system for an automobile in which the optimal shift pattern is formed in conformity with a driving environment (such as  
10 driving on a mountain path, or driving with many passengers on board), thereby enhancing the drivability of the automobile, and in which the fuel consumption of the automobile is enhanced more than in the prior art when driving on a flat road.



## WHAT IS CLAIMED IS:

1           1. An automatic transmission control system for an  
2 automobile, comprising:

3                 load computation means for computing a load of said  
4 automobile;

5                 output torque estimation means for calculating an  
6 output torque with reference to torque characteristics of a  
7 drive train of said automobile;

8                 running load estimation means for estimating a  
9 running load from the automobile load and said output  
10 torque;

11                memory means for storing at least two shift  
12 schedules therein; and

13                a shift schedule variable-control unit which  
14 determines a shift schedule of an automatic transmission of  
15 said drive train during actual running of said automobile,  
16 on the basis of the estimated running load and the stored  
17 shift schedules..

1           2. An automatic transmission control system for an  
2 automobile as defined in Claim 1, wherein said output torque  
3 estimation means calculates said output torque with  
4 reference to, at least, the torque characteristics of a  
5 torque converter of said automatic transmission.

1           3. An automatic transmission control system for an

2 automobile as defined in Claim 1, wherein said output torque  
3 estimation means calculates said output torque by  
4 calculating an output torque of a torque converter of said  
5 automatic transmission with reference to, at least, the  
6 torque characteristics of said torque converter, and further  
7 multiplying the calculated output torque of said torque  
8 converter by a gear ratio of a gear stage of said automatic  
9 transmission corresponding to a shift instruction.

1 4. An automatic transmission control system for an  
2 automobile as defined in Claim 1, wherein said output torque  
3 estimation means calculates said output torque with  
4 reference to, at least, the torque characteristics of a  
5 torque converter of said automatic transmission and those of  
6 an engine of said drive train.

1 5. An automatic transmission control system for an  
2 automobile as defined in Claim 1, wherein said output torque  
3 estimation means calculates said output torque by changing-  
4 over the torque characteristics of an engine of said drive  
5 train and those of a torque converter of said automatic  
6 transmission when a ratio between an input revolution speed  
7 and an output revolution speed of said torque converter has  
8 exceeded a predetermined value.

1 6. An automatic transmission control system for an

2 automobile as defined in Claim 1, further comprising:

3 a neural network which has been supplied  
4 with values of, at least, a throttle valve opening and  
5 an acceleration so as to learn values of a vehicle weight  
6 corresponding to the supplied values beforehand;

7 said load computation means being vehicle weight  
8 estimation means for estimating said vehicle weight of said  
9 automobile;

10 said vehicle weight estimation means estimating  
11 said vehicle weight by time-serializing each of, at least,  
12 said throttle valve opening and said acceleration and then  
13 supplying resultant time-serial signals to said neural  
14 network.

1 7. An automatic transmission control system for an  
2 automobile as defined in Claim 6, wherein said vehicle  
3 weight estimation means supplies said time-serial signals of  
4 said throttle valve opening and said acceleration at a  
5 timing at which said throttle valve opening has exceeded a  
6 predetermined value and at which said acceleration has also  
7 exceeded a predetermined value.

1 8. An automatic transmission control system for an  
2 automobile as defined in Claim 1, wherein said shift  
3 schedule variable-control unit varies a speed change line of  
4 said automatic transmission continuously in dependency on

5       said running load.

1           9. An automatic transmission control system for an  
2       automobile as defined in Claim 1, wherein said shift  
3       schedule variable-control unit varies a speed change line of  
4       said automatic transmission continuously in dependency on,  
5       at least, a vehicle weight of said automobile.

1           10. An automatic transmission control system for an  
2       automobile as defined in Claim 1, wherein said shift  
3       schedule variable-control unit varies a speed change line of  
4       said automatic transmission continuously in dependency on an  
5       inclination angle of the running automobile and a vehicle  
6       weight of said automobile.

1           11. An automatic transmission control system for an  
2       automobile as defined in Claim 1, wherein said shift  
3       schedule variable-control unit varies a speed change line of  
4       said automatic transmission continuously in dependency on an  
5       inclination angle of the running automobile, a vehicle  
6       weight of said automobile, and a request for an accelerating  
7       operation made by a driver of said automobile.

1           12. An automatic transmission control system for an  
2       automobile as defined in Claim 1, wherein:

3                said load computation means is vehicle weight

4 estimation means for estimating a vehicle weight of said  
5 automobile;

6 said vehicle weight estimation means includes  
7 acceleration input means for accepting an acceleration  
8 signal;

9 said running load estimation means estimates  
10 said running load from the estimated vehicle weight, the  
11 calculated output torque and the accepted acceleration; and

12 said shift schedule variable-control unit is gear  
13 position determination means for selecting one of said shift  
14 schedules in accordance with said estimated vehicle weight  
15 and the estimated running load, and for determining a gear  
16 position of said automatic transmission in conformity with  
17 the selected shift schedule.

1 13. An automatic transmission control system for an  
2 automobile as defined in Claim 12, wherein:

3 said vehicle weight estimation means estimates  
4 said vehicle weight of said automobile by accepting a  
5 throttle valve opening signal and a vehicle speed signal in  
6 addition to said acceleration signal;

7 said torque estimation means estimates said output  
8 torque by accepting a revolution speed signal of an engine  
9 of said drive train and a turbine revolution speed signal of  
10 a torque converter of said automatic transmission; and

11 said running load estimation means estimates said

12 running load from said acceleration signal, said estimated  
13 vehicle weight and the estimated output torque.

1 14. An automatic transmission control system for  
2 an automobile as defined in Claim 12, wherein said torque  
3 estimation means has a mode in which said output torque is  
4 estimated from a turbine revolution speed of a torque  
5 converter of said automatic transmission and a revolution  
6 speed of an engine of said drive train, and a mode in which  
7 said output torque is estimated from a throttle valve  
8 opening of said engine and said revolution speed of said  
9 engine, said modes being established in dependency on a  
10 revolution ratio of a torque converter of said automatic  
11 transmission.

1 15. An automatic transmission control system for an  
2 automobile as defined in Claim 12, wherein said running load  
3 estimation means estimates said running load by solving an  
4 equation of motion on the basis of said vehicle weight,  
5 said output torque and said acceleration of said automobile.

1 16. An automatic transmission control system for an  
2 automobile, comprising:

3 vehicle weight measurement means for measuring a  
4 vehicle weight of said automobile;

5 torque estimation means for estimating an output

6 torque;

7 acceleration input means for accepting an  
8 acceleration;

9 running load estimation means for estimating a  
10 running load from the measured vehicle weight, the estimated  
11 output torque and the input acceleration;

12 memory means for storing at least two shift  
13 schedules therein; and

14 gear position determination means for determining  
15 a shift schedule of an automatic transmission of said drive  
16 train during actual running of said automobile, on the basis  
17 of said vehicle weight, the estimated running load and the  
18 stored shift schedules, and for determining a gear position  
19 of said automatic transmission in accordance with the  
20 determined shift schedule.

1 21. An automatic transmission control system for an  
2 automobile as defined in Claim 12, further comprising start  
3 signal generation means for delivering an acceptance start  
4 signal in synchronism with rise of said acceleration signal  
5 when said acceleration signal is to be accepted.

## ABSTRACT

An automatic transmission control system for an automobile, comprising a vehicle weight estimation unit (106 in Fig. 1) which estimates a vehicle weight of the automobile; a torque estimation unit (107, 1001) which estimates an output torque, an acceleration input unit (102) which accepts an acceleration signal; a load estimation unit (110) which estimates a running load from the estimated vehicle weight, the estimated output torque and the accepted acceleration; a memory which stores a plurality of shift schedules therein; and a gear position determination unit (109) which includes the memory, and which selects one of the shift schedules in accordance with the vehicle weight and the estimated running load, so as to determine a gear position of an automatic transmission of the automobile in conformity with the selected shift schedule. An exact shift operation conformed to the vehicle weight and the running load can be performed, and an enhanced fuel consumption can be attained.



FIG.1

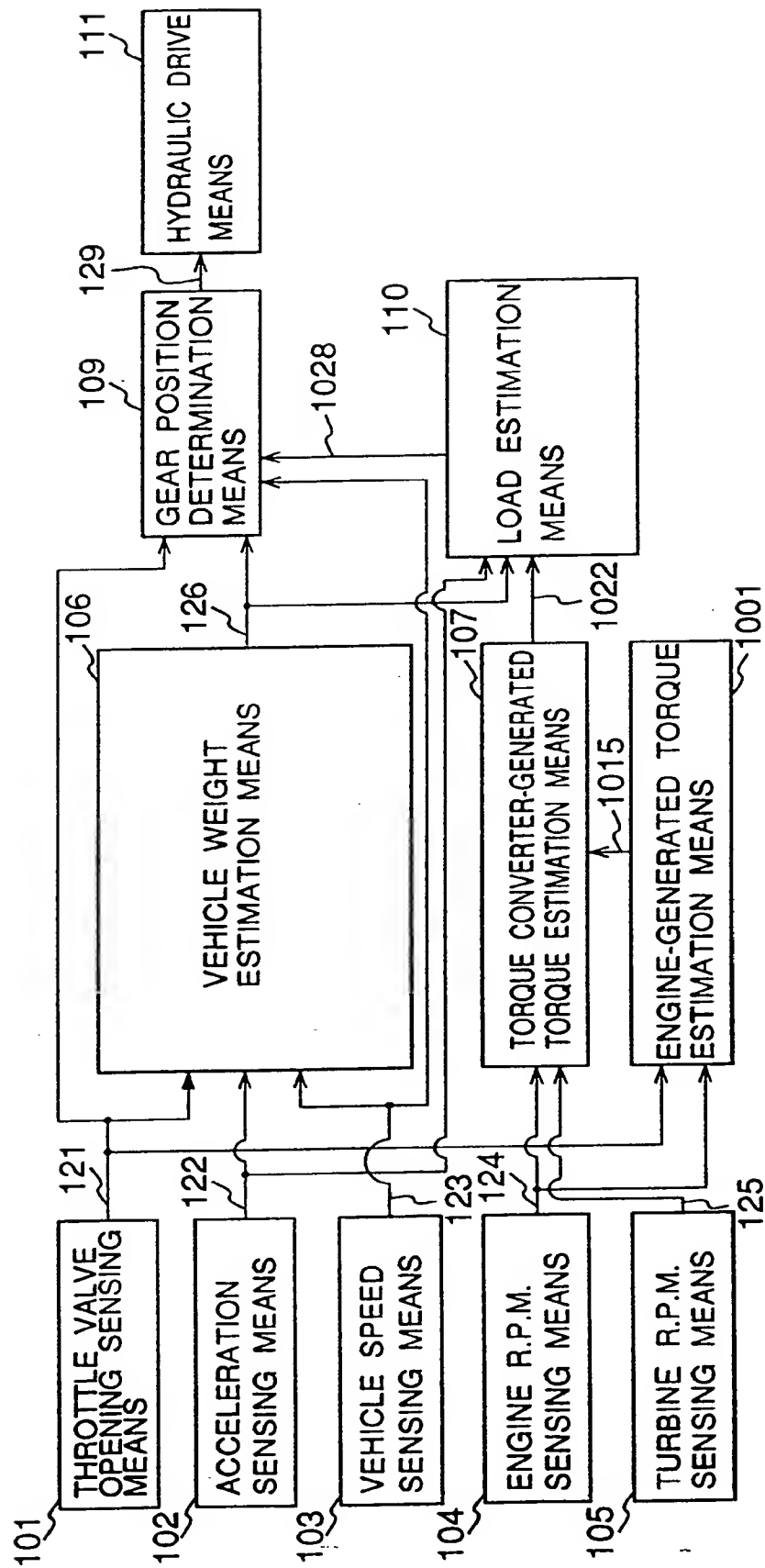


FIG.2

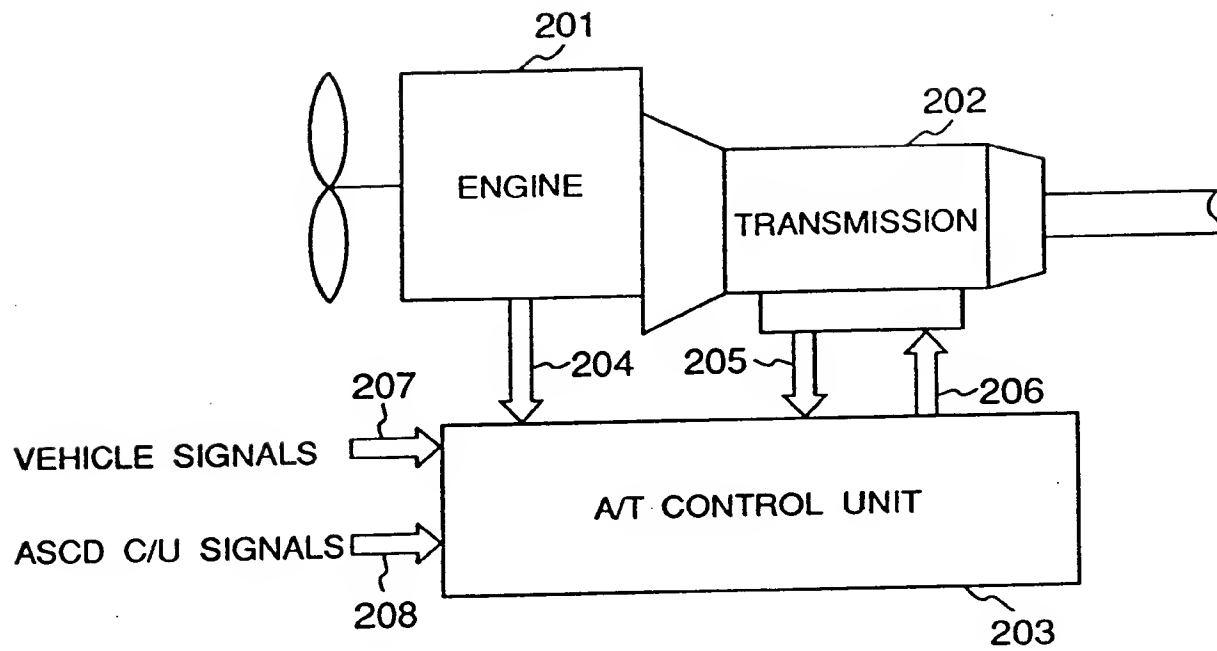


FIG.3

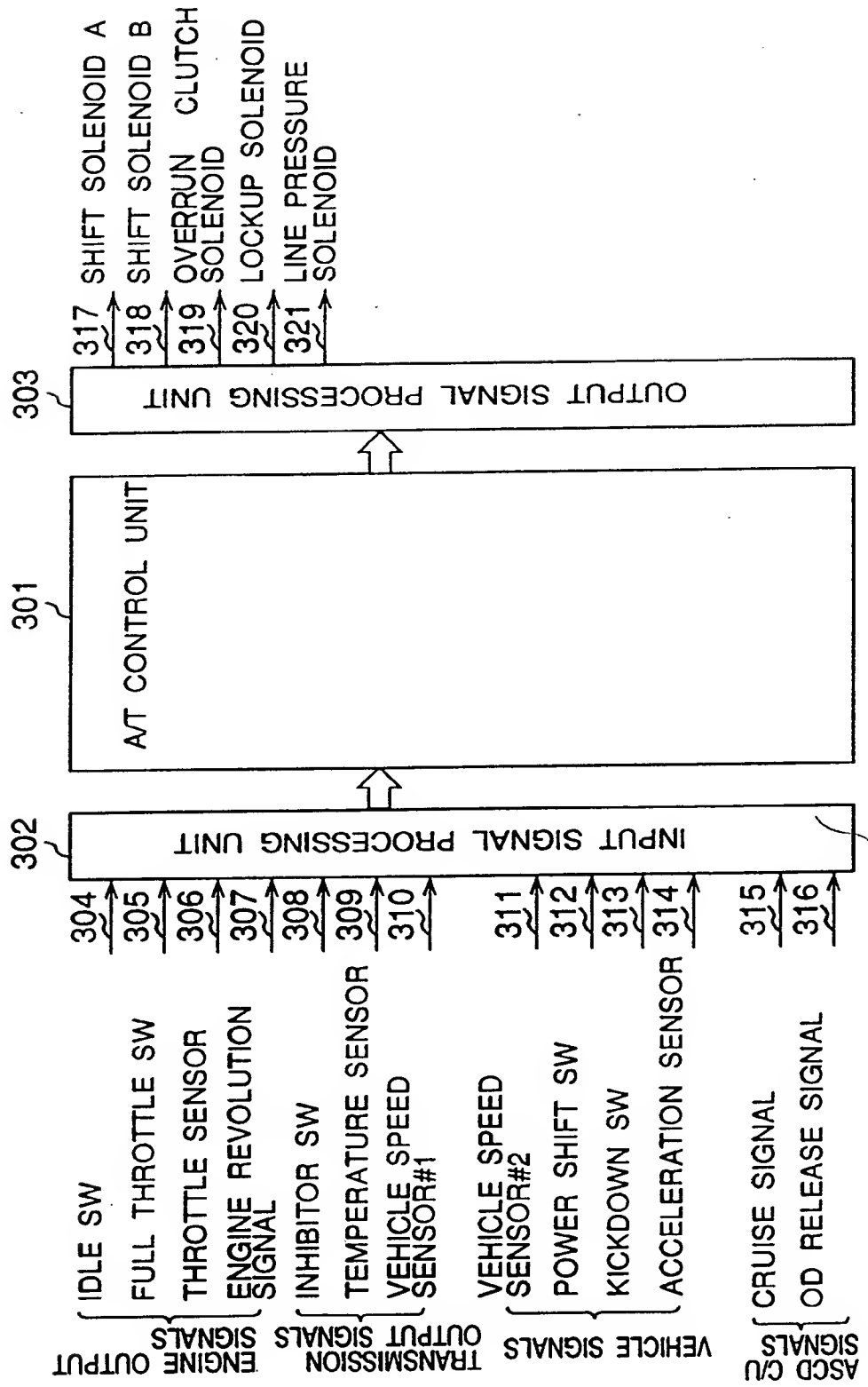


FIG.4

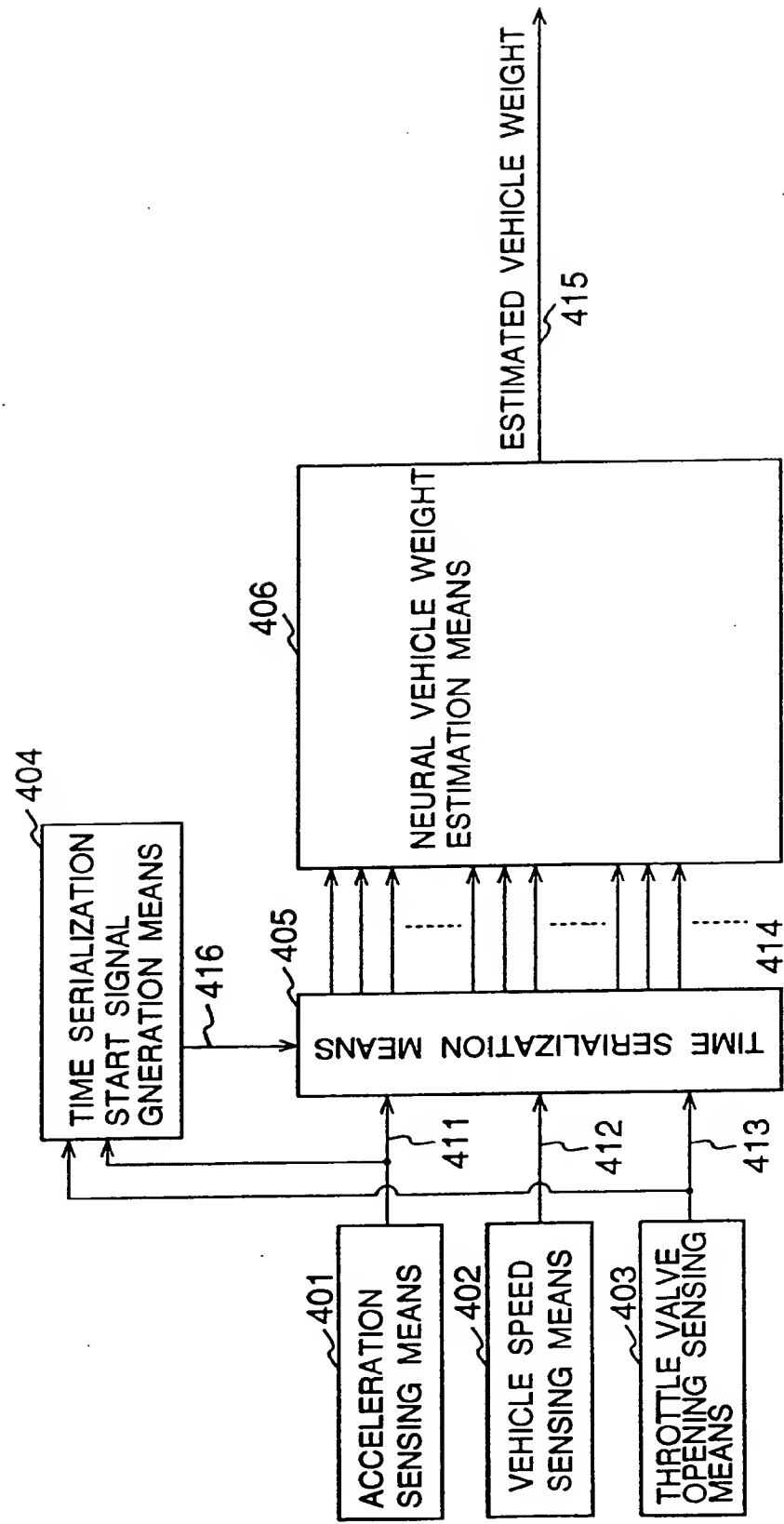


FIG.5

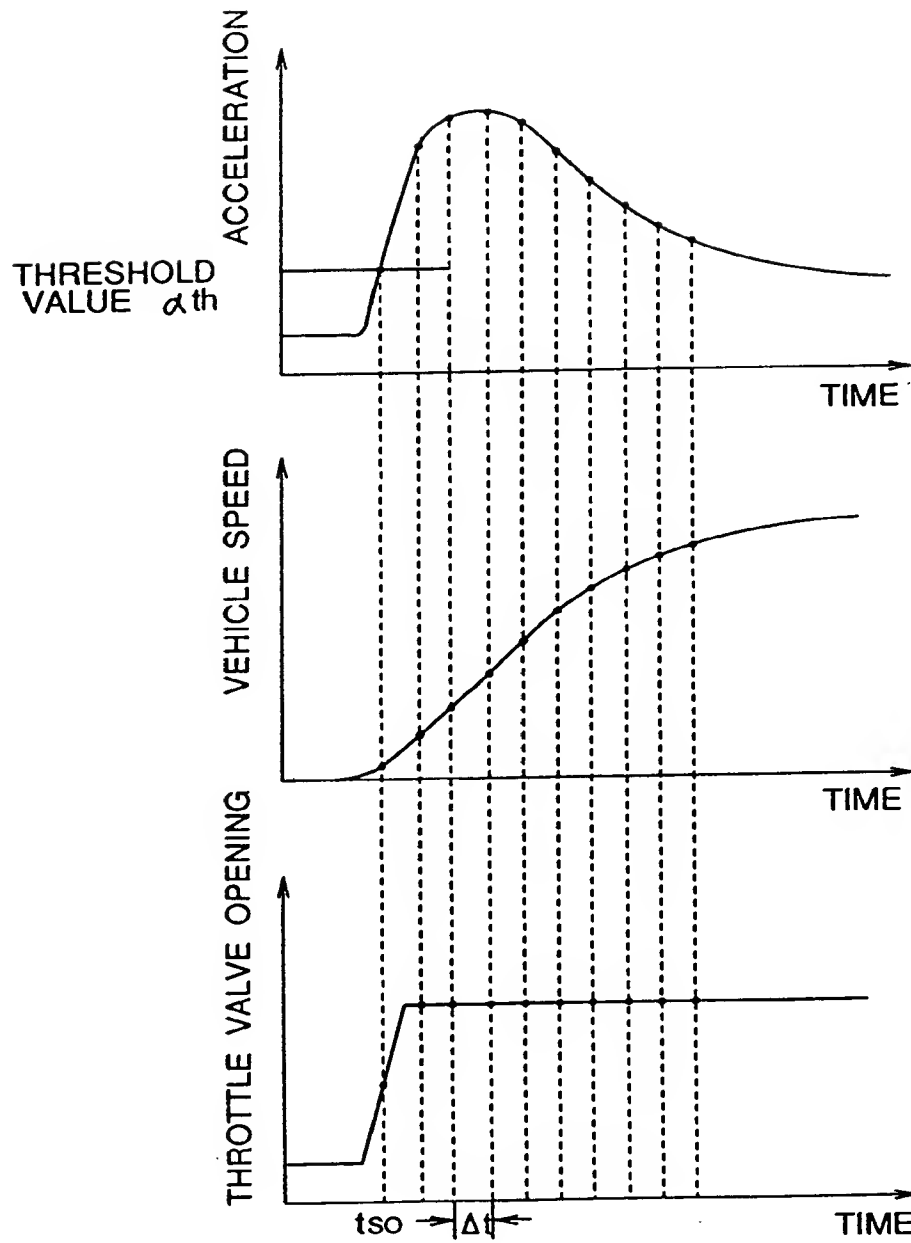


FIG.6 (a)

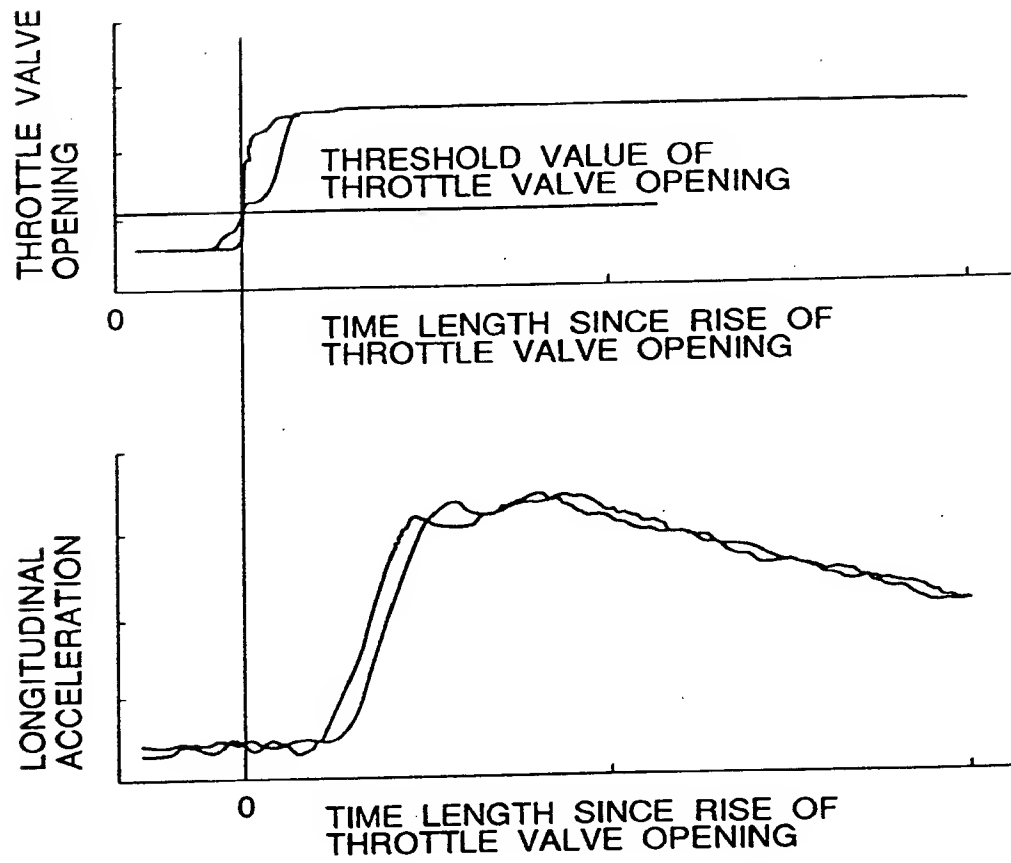


FIG.6 (b)

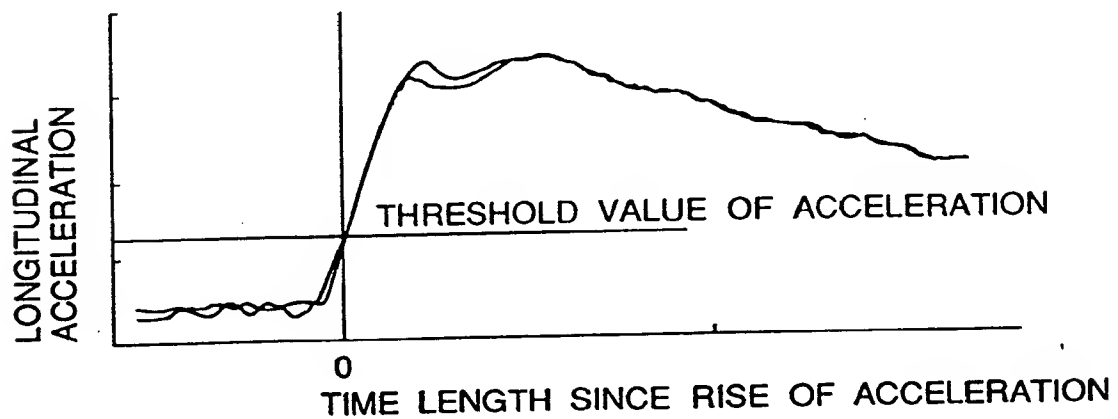


FIG.7

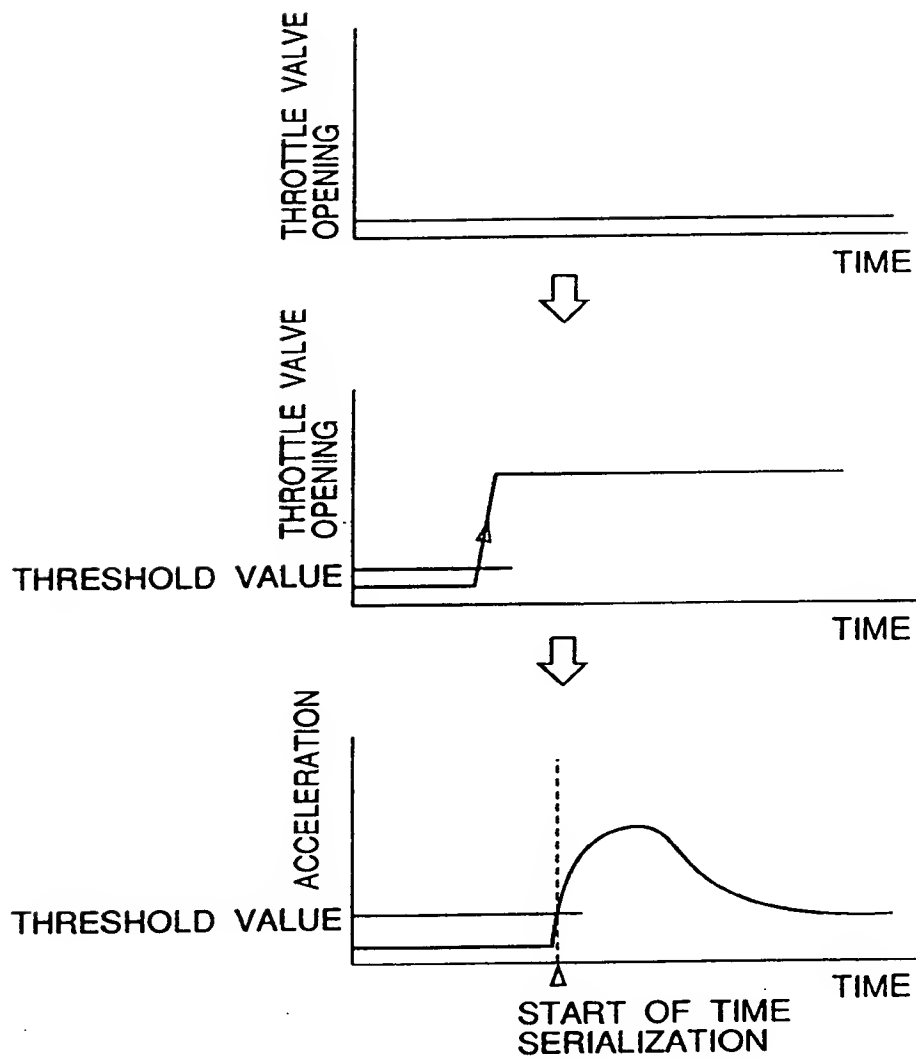


FIG.8

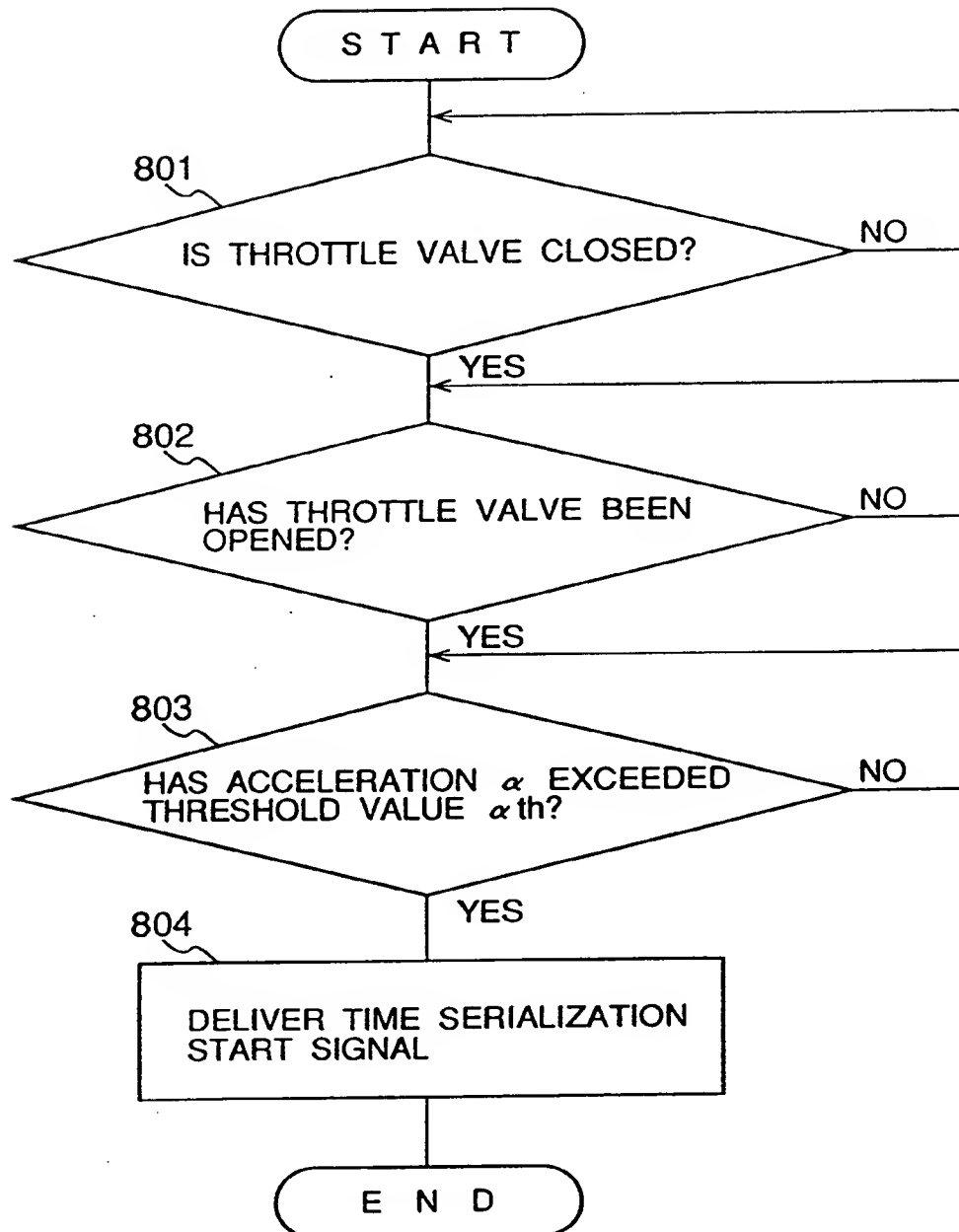




FIG.9

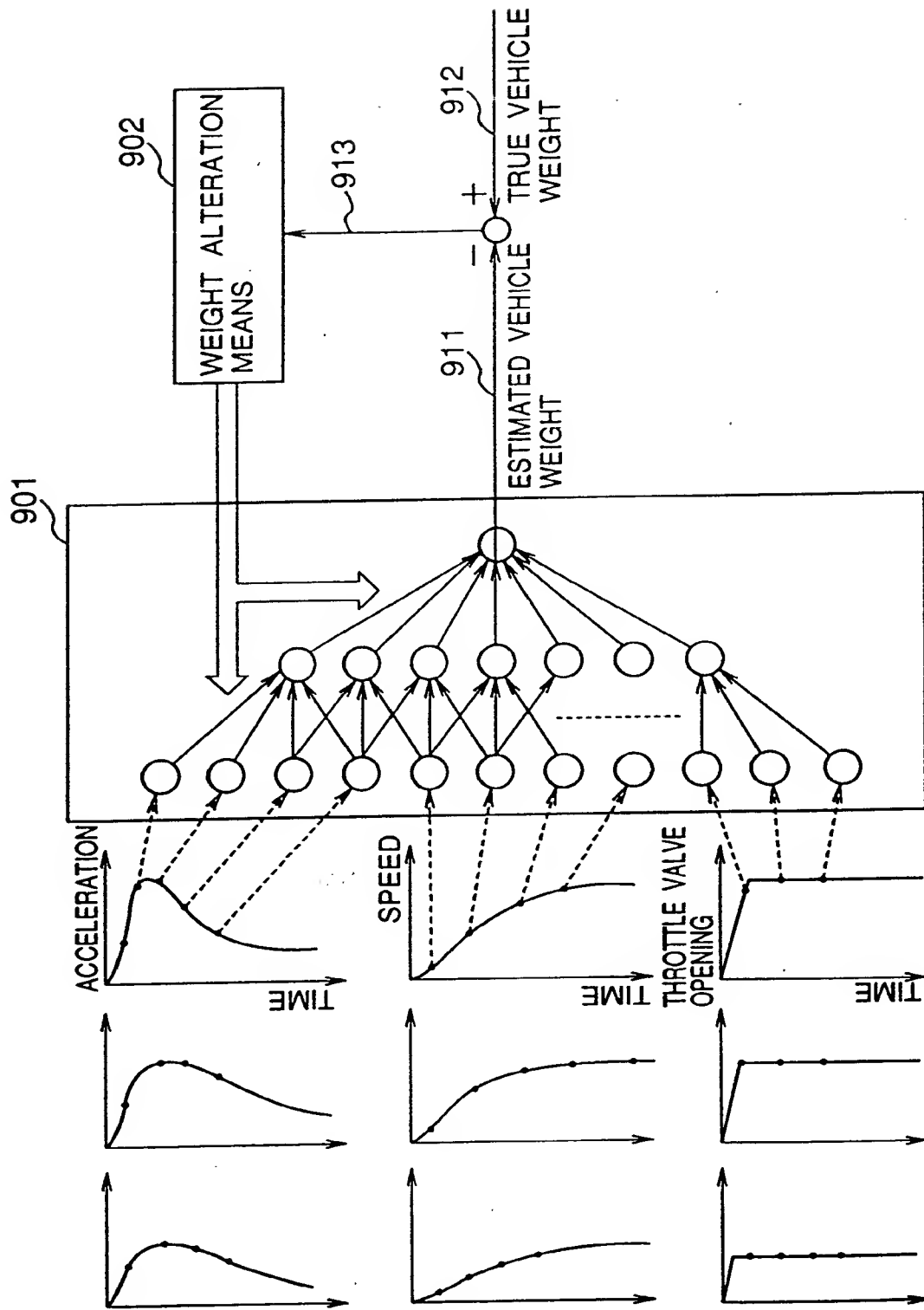


FIG.10

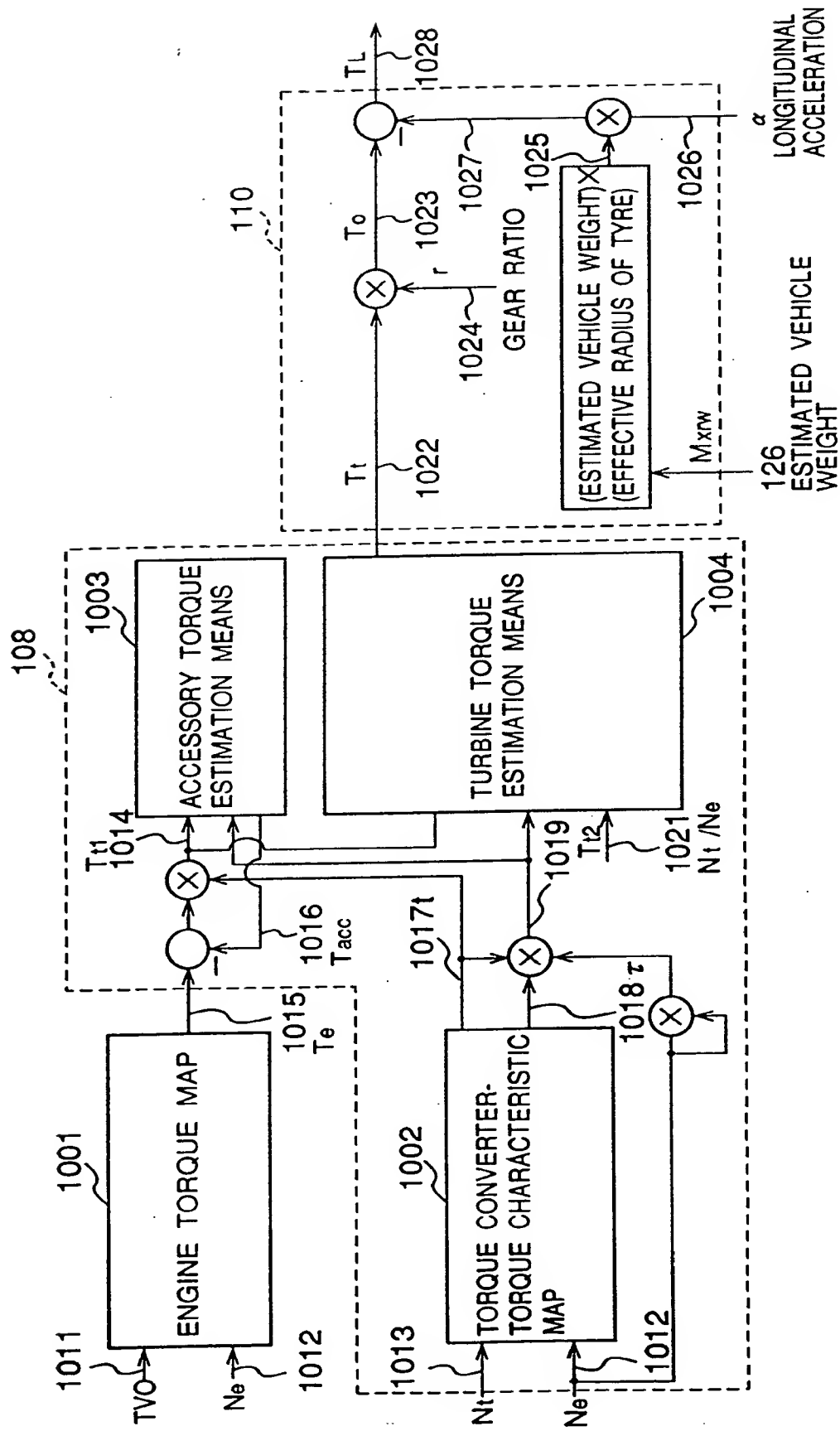


FIG.11 (a)

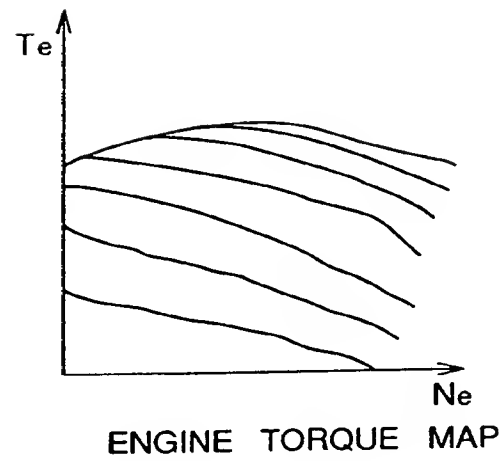


FIG.11 (b)

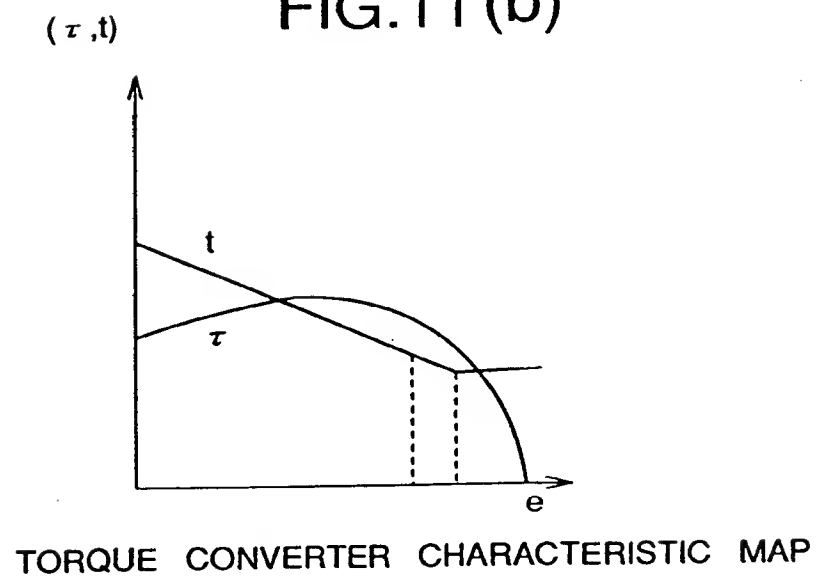


FIG.12

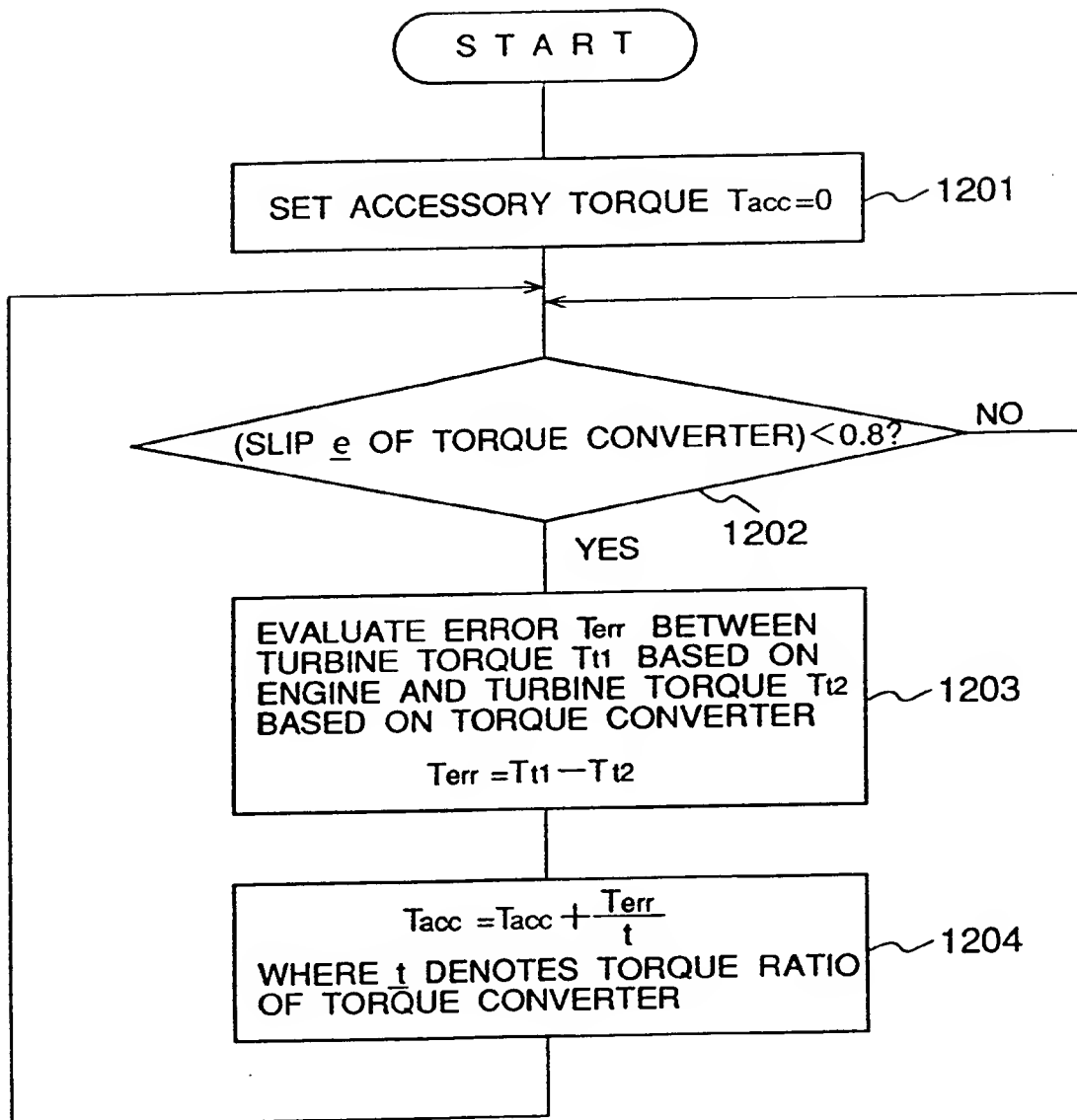


FIG.13

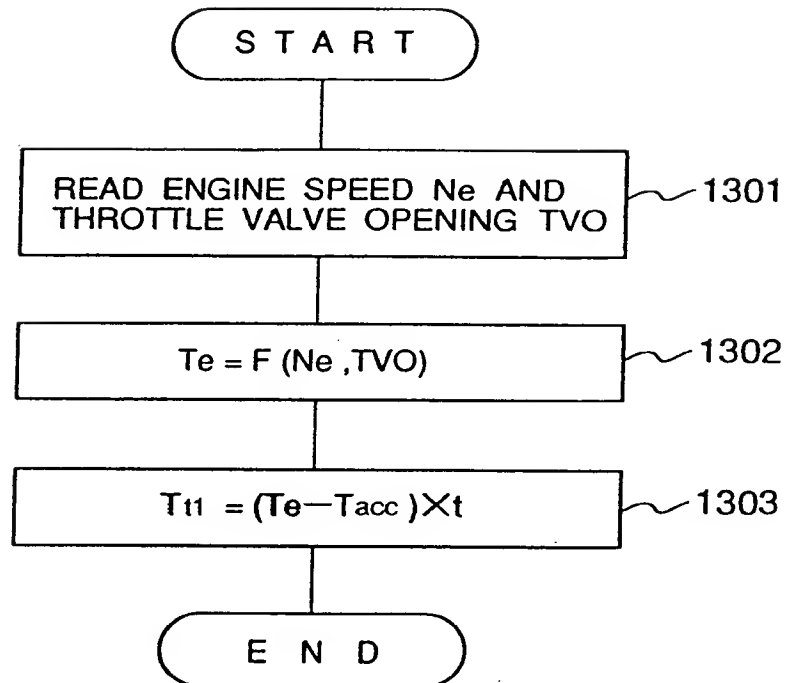


FIG.16

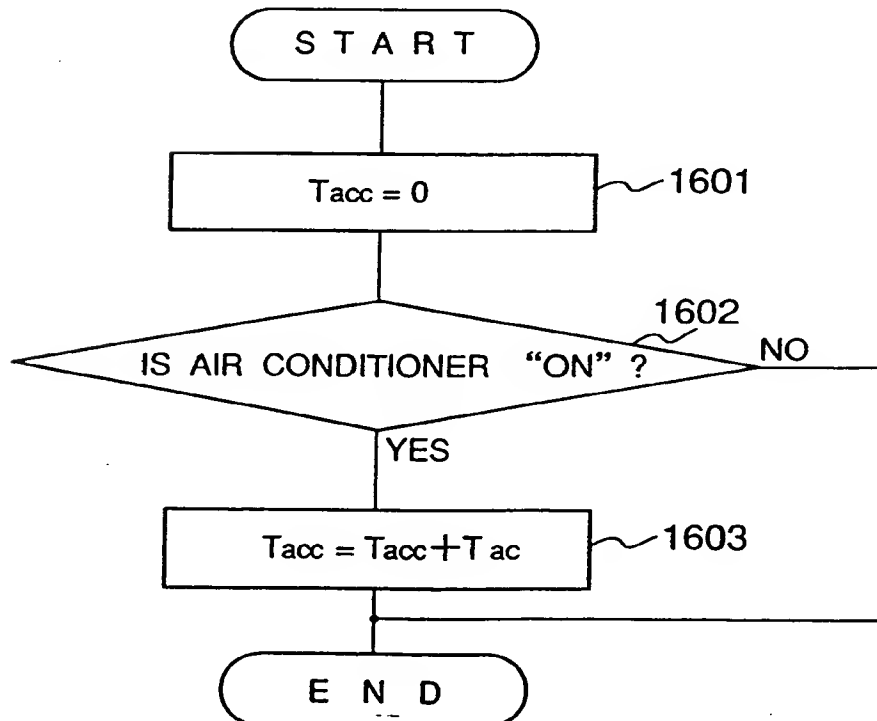


FIG.14

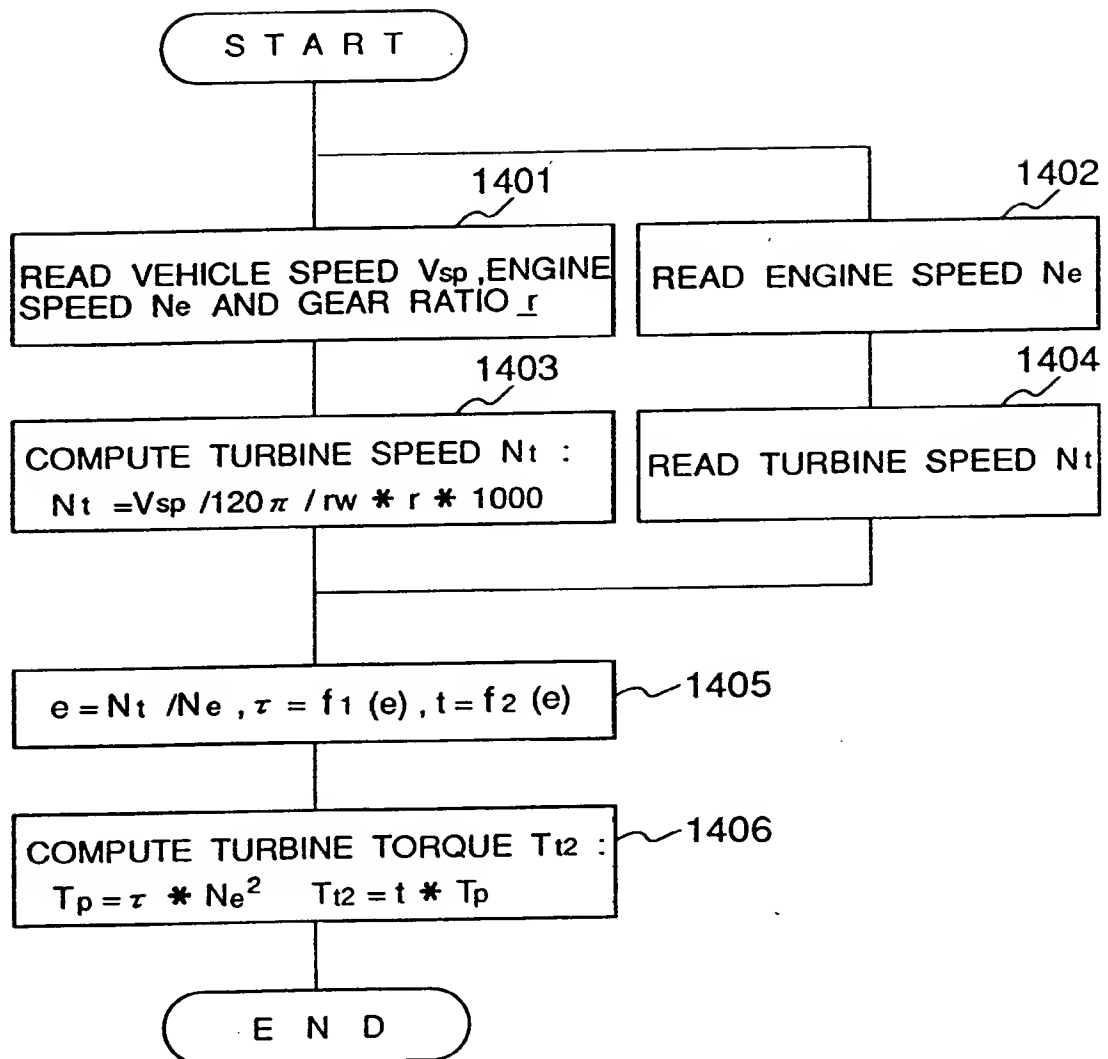
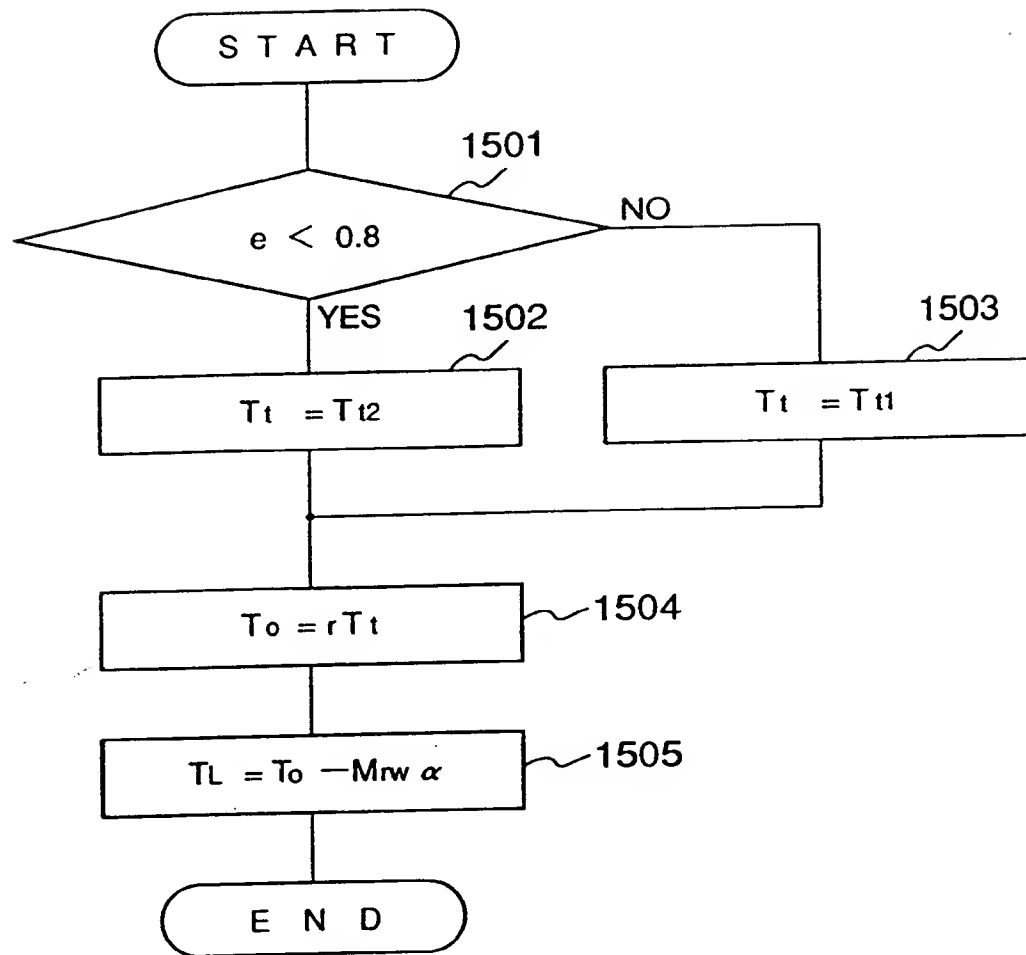


FIG.15



【図16】

図 16

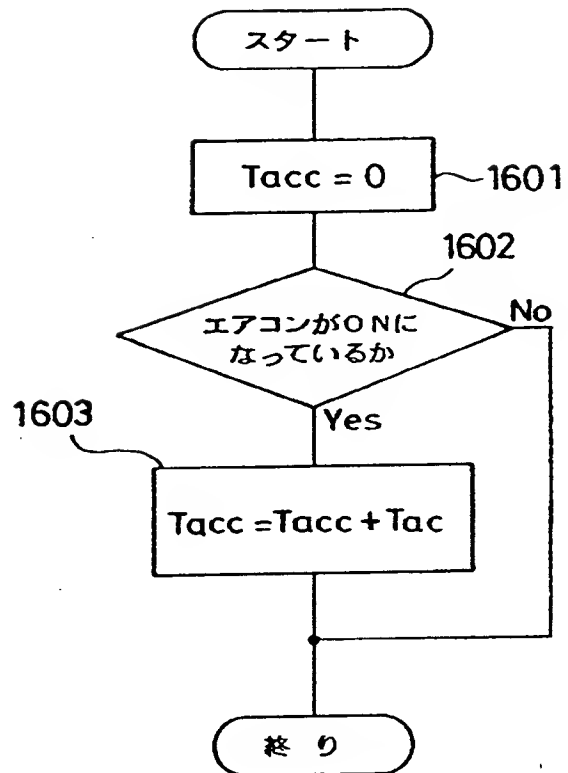




FIG.17

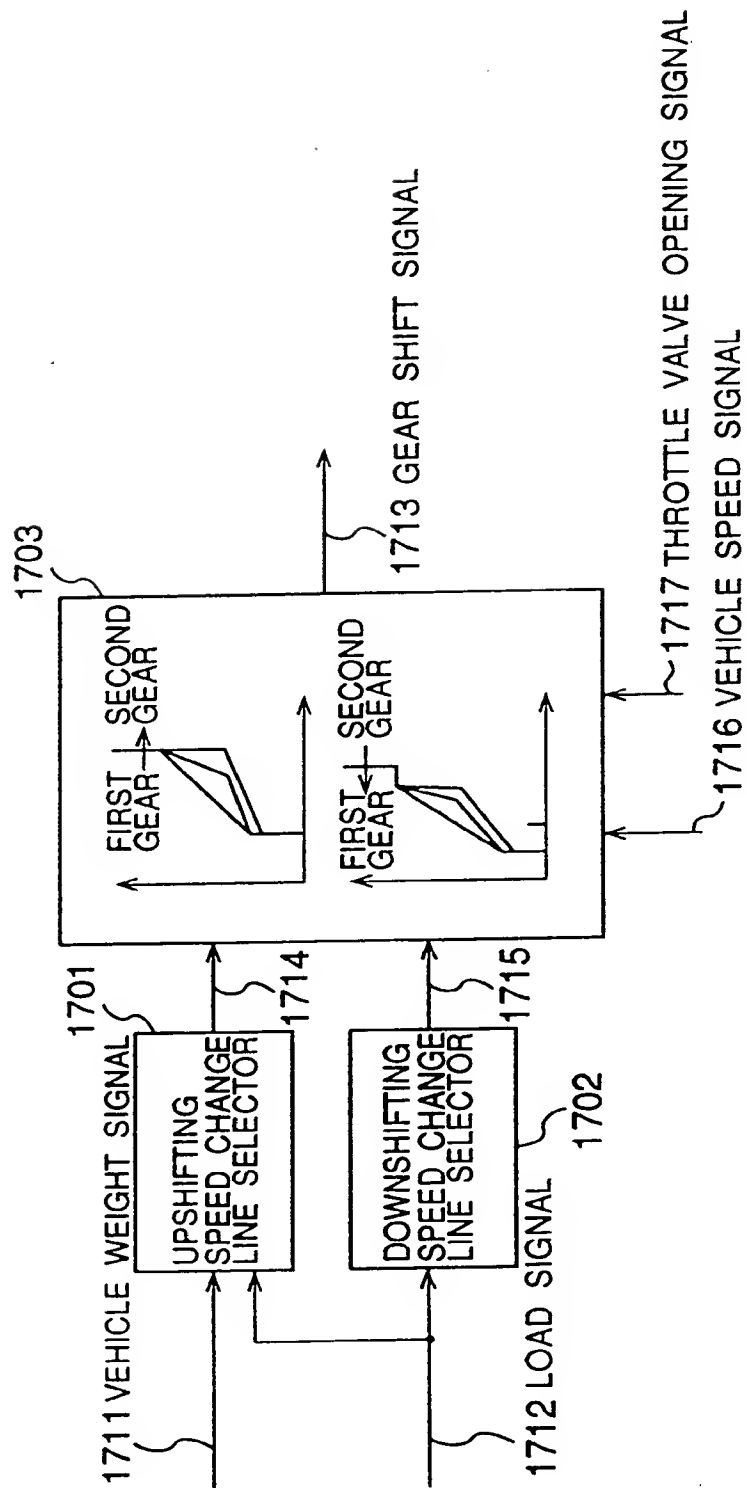


FIG.18 (a)

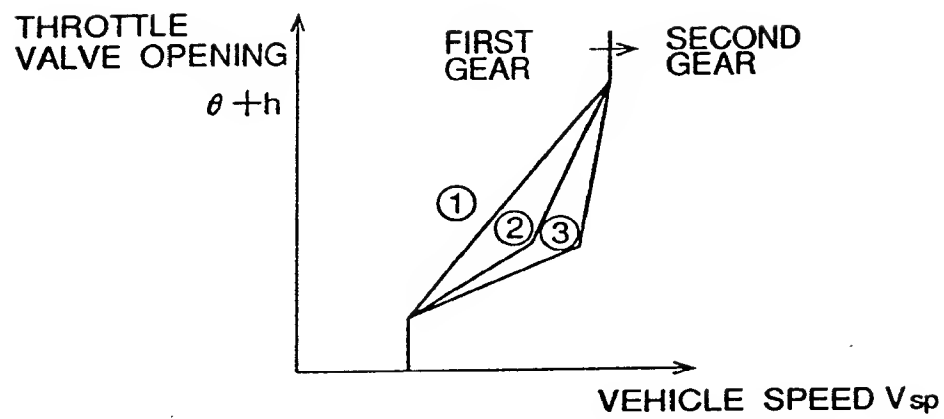


FIG.18 (b)

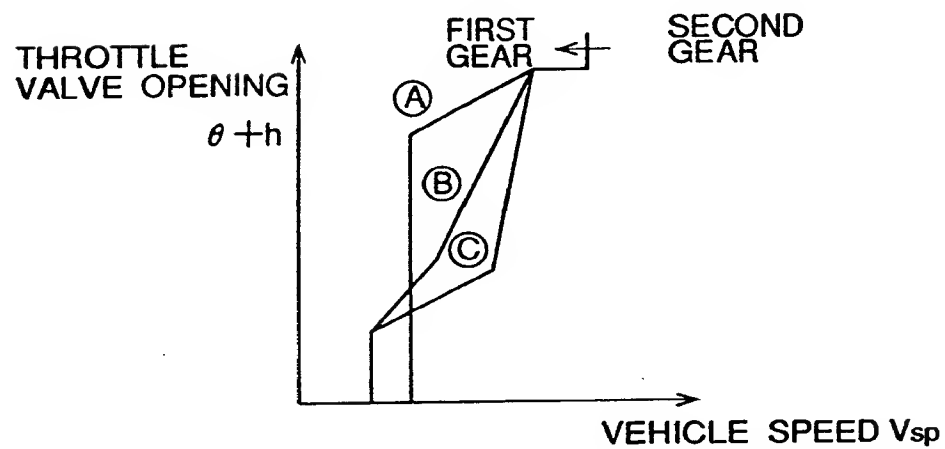


FIG.19

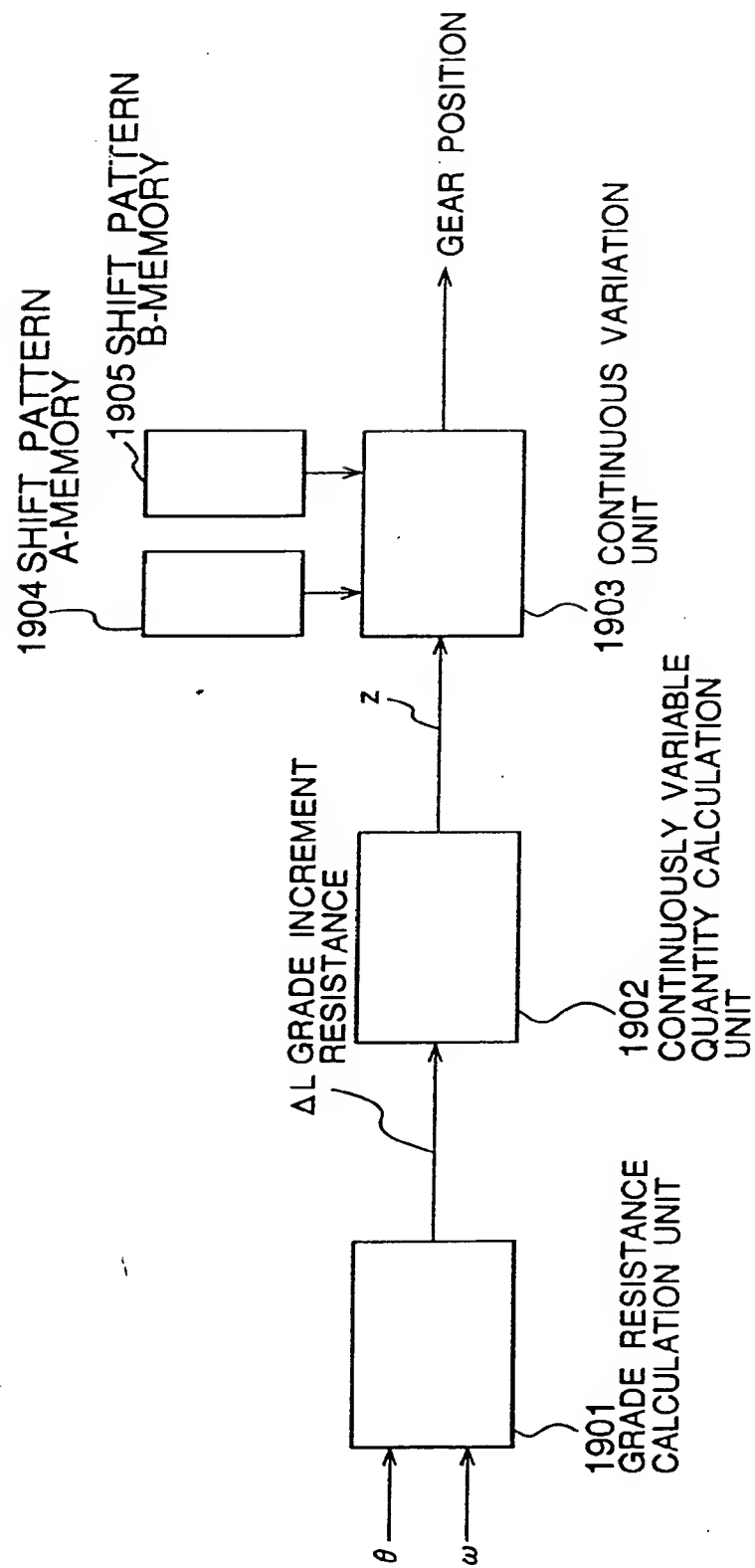


FIG.20

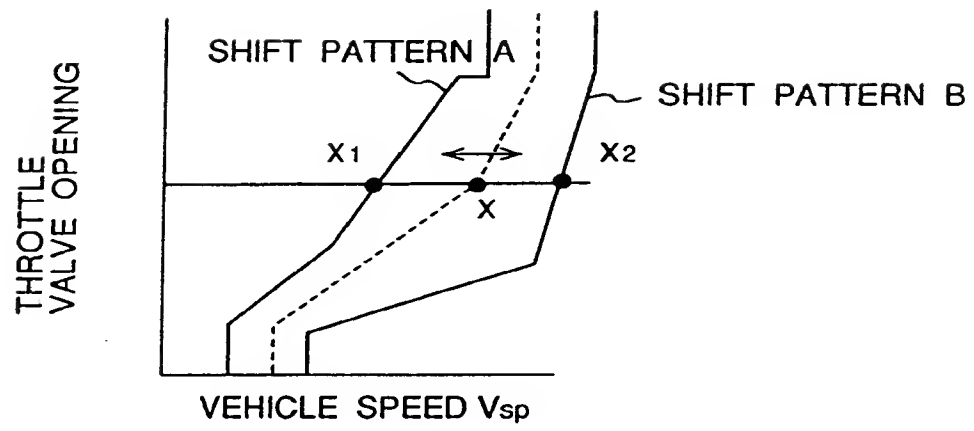


FIG.21(a)

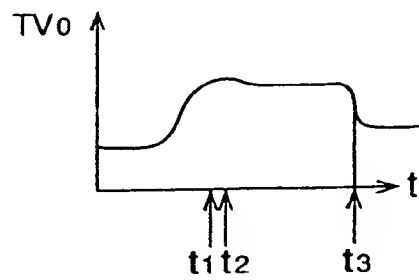


FIG.21(b)

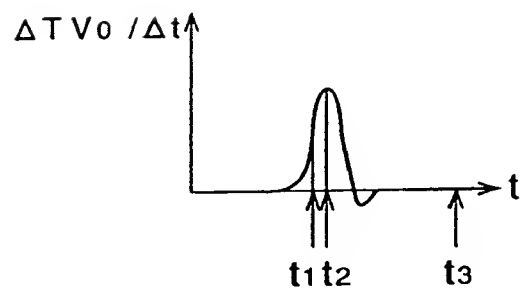
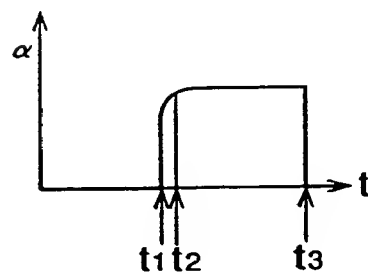


FIG.21(c)





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事項と同一であることを証明する。

is to certify that the annexed is a true copy of the following application as filed  
in this Office.

GROUP 35U

願年 月 日  
of Application:

1991年12月 3日

願番 号  
Application Number:

平成 3年特許願第319205号

願 人  
Applicant(s):

株式会社日立製作所

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GROUP 35U

1992年10月30日

特許庁長官  
Commissioner,  
Patent Office

麻生



出証平 04-063184

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ATTORNEY DOCKET NO. 381/41092  
PATENT APPLICATION

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE  
GROUP 350

In re application of  
Hiroshi ONISHI et al.

Appln. No.: Not yet assigned

Group Art Unit:

Filed: December 3, 1992

Examiner:

For: AUTOMATIC TRANSMISSION CONTROL SYSTEM FOR AN AUTOMOBILE

PRELIMINARY AMENDMENT

BOX NON-FEE AMENDMENT  
Honorable Commissioner of  
Patents and Trademarks  
Washington, D.C. 20231

December 3, 1992

Sir:

Please enter the following amendment to the specification  
prior to the examination of the application.

IN THE SPECIFICATION:

Page 5, after line 4, insert the following paragraph:

-- Other objects, advantages and novel features of the present  
invention will become apparent from the following detailed  
description of the invention when considered in conjunction with  
the accompanying drawings.--.

Page 20, line 15, after "TVO" insert --are read--.

Page 21, line 25, delete "If" and insert --Whether--; and  
line 26, delete ", " after "0.8".

Page 24, line 1, delete "moves" and insert --follows--;

line 2, delete "along", delete "and" (first occurrence)  
and insert --or-- therein, delete "as" and insert --dependent

on--, and after "load" insert --, moving from line 1 → 2 → 3  
as such weight and speed increase.--;

line 3, delete "enlarge"; and

line 4, delete "along" and insert --between-- therein.

Page 28, after line 14, insert the following paragraph:

-- Although the invention has been described and illustrated  
in detail, it is to be clearly understood that the same is by way  
of illustration and example, and is not to be taken by way of  
limitation. The spirit and scope of the present invention are  
to be limited only by the terms of the appended claims.--.

IN THE CLAIMS:

Please amend the claims as follows and add new Claims 22-26  
as follows:

Claim 1, line 3, delete "a" and insert --an automobile--;  
and

line 6, delete "with reference to" and insert --based  
on--.

Claim 2, line 3, delete "with"; and

line 4, delete "reference to," and insert --in response  
to-- and also delete ", the".

Claim 3, line 5, delete "with reference to," and insert --in  
response to-- and also delete ", the"; and

line 6, delete "said" and insert --a-- and delete  
"further" and insert --by--.



Claim 4, line 3, delete "with" and insert --in--; and  
line 4, delete "reference" and insert --response--.

Claim 5, line 4, after "over" insert --between--.

Claim 6, line 3, delete "has been supplied" and insert --  
receives";

line 4, delete "with values of, at least," and insert  
--values of at least-- therein;

line 6, delete "supplied values" and insert --values  
supplied--;

line 7, delete "being" and insert --comprising--;

line 9, after "automobile;" insert --and--; and

line 11, delete ",", (both occurrences).

7. (Amended) An automatic transmission control system for  
an automobile as defined in Claim 6, wherein said vehicle weight  
estimation means [supplies] includes means for supplying said  
time-serial signals of said throttle valve opening and said  
acceleration, commencing when [at a timing at which] said  
throttle valve opening has exceeded a predetermined value and [at  
which] said acceleration has also exceeded a predetermined value.

Claim 8, line 4, delete "dependency on" and insert  
--response to--.

Claim 9, line 4, delete "dependency on," and insert  
--response to--; and

line 5, delete ",."

Claim 10, line 4, delete "dependency on" and insert  
--response to--; and  
line 5, delete "running" and after "automobile", insert  
--when it is in motion--.

Claim 11, line 4, delete "dependency on" and insert  
--response to--; and  
line 5, delete "running" and insert --when it is in  
motion--.

Claim 12, line 3, delete "is" and insert --comprises--;  
line 7, delete "accepting" and insert --receiving--;  
line 11, delete "accepted" and insert --received--;  
line 12, delete "is" and insert --comprises--; and  
line 15, delete "determining" and insert --selecting--.

13. (Amended) An automatic transmission control system for  
an automobile as defined in Claim 12, wherein:

said vehicle weight estimation means estimates said vehicle  
weight of said automobile [by accepting] in response to a  
throttle valve opening signal and a vehicle speed signal in  
addition to said acceleration signal;

said torque estimation means estimates said output torque  
[by accepting] in response to a revolution speed signal of an  
engine of said drive train and a turbine revolution speed signal  
of a torque converter of said automatic transmission; and

said running load estimation means estimates said running load [from] in response to said acceleration signal, said estimated vehicle weight and the estimated output torque.

Claim 14, line 9, delete "dependency on" and insert --response to--.

Claim 16, line 7, delete "accepting" and insert --receiving--;

line 8, after "acceleration" insert --signal--;

line 11, delete "input acceleration" and insert --received acceleration signal--.

Claim 21, line 1, change "21" to --17--.

IN THE ABSTRACT:

Line 4, delete "(106";

line 5, delete "in Fig. 1)"

line 6, delete ";" and "(107, 1001)";

line 7, delete "(102)";

line 9, delete "(110)"; and

line 13, delete "(109)".

Please add the following new claims:

--18. Method of controlling an automatic transmission for an automobile having means for storing a plurality of shift schedules for said automatic transmission, said method comprising the steps of:

first, calculating a value for an automobile load of said automobile and generating an automobile load signal indicative thereof;

second, calculating a value for an output torque of said transmission based on torque characteristics of a drive train of said automobile and generating an output torque signal indicative of said output torque value;

third, estimating a running load of said automobile based on said automobile load signal and said output torque signal; and

fourth, selecting a shift schedule from among a plurality of shift schedules stored in said means for storing, based on the estimated running load.

19. Method according to Claim 18, wherein said second step comprised calculating said output torque based on at least torque characteristics of a torque converter of said automatic transmission.

20. Method according to Claim 18, wherein said second step comprises calculating said output torque based on at least torque characteristics of a torque converter of said automatic transmission, and those of an engine of said drive train.

21. Method according to Claim 18, wherein said second step comprises calculating said output torque based on torque characteristics of an engine of said drive train when a ratio between an input revolution speed and an output revolution speed is greater than a predetermined value, and calculating said

output torque based on torque characteristics of a torque converter of said automatic transmission when said ratio is less than said predetermined value.

22. Method according to Claim 20, wherein said second step comprises calculating said output torque based on torque characteristics of an engine of said drive train when a ratio between an input revolution speed and an output revolution speed is greater than a predetermined value, and calculating said output torque based on torque characteristics of a torque converter of said automatic transmission when said ratio is less than said predetermined value.

#### REMARKS

Entry of the amendment to the Specification, Abstract and Claims, before examination of the application is respectfully requested.

If there are any questions regarding this Preliminary Amendment or this application in general, a telephone call to the undersigned would be appreciated since this should expedite the prosecution of the application for all concerned.

It is respectfully requested that, if necessary to effect a timely response, this paper be considered as a Petition for an Extension of Time sufficient to effect a timely response and shortages in other fees, be charged, or any overpayment in fees be credited, to the Account of Evenson, Wands, Edwards, Lenahan & McKeown, Deposit Account No. 05/1323 (381/41092).

Respectfully submitted,

EVENSON, WANDS, EDWARDS,  
LENAHAN & McKEOWN

A handwritten signature in cursive script, appearing to read "Donald D. Evenson". The signature is written in dark ink and is positioned above a horizontal line.

Donald D. Evenson  
Registration No. 26,160

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